

FareXChange

A NeTEx Profile

for exchanging UK
Bus Fares data

Part 1 – Overview FXCP-IN

1.1 [review DRAFT]

Document Control Log

Date	Modified by	Comment	Version
2018.07.10	NJSK	Initial Rough Draft	V0.1
2018.08.18	NJSK	Working Draft	V0.2
2018.12.18	NJSK	Working Draft	V0.3
2019.01.25	NJSK	Working Draft	V0.5
2019.03.16	NJSK	Working Draft	V0.6
2019.05.17	NJSK	Revised for comment	V0.7
2019.05.27	NJSK	Initial Draft for comment	V0.8
2019.06.187	NJSK	Initial Draft for comment	V0.9

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2 Introduction

This document describes the overall scope of the UK Fare Exchange profile (FXCP); A specification for representing UK Bus Fare data in NeTEx, a CEN standard for exchanging public transport data as XML documents. It is the first of three documents describing the UK profile.

- For an overview of the UK Profile scope -see UK Profile Part 1 (This document). (FXCP-IN)
- For a description of the basic (non-fare) elements, see UK Profile Part 2 (FXCP-NT).
- For a description of the Fare elements, see UK Profile Part 3 (FXCP-FM).

Whereas the second two documents are necessarily very technical in nature, this first document is intended give an overview for less technical readers as well. This introduction focuses mainly on fare data and is concerned with the following questions.

➤ Scope of UK Bus fare standard

1. What types of tariff structures and fare products should be covered for UK Bus fares?
2. What aspects of the selected fares and tariffs need to be represented?
3. What workflows are envisaged for exchanging fares?

The subsequent two documents provide a detailed specification, including the following aspects of the profile.

➤ Using NeTEx for UK Fares

1. Which NeTEx data elements should be used to represent the fares? (As a selection of entities, attributes and attribute values found in the full NeTEx XML schema.)

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2. How to allocate unique identifiers to data elements?
3. How to reference existing UK data sets where relevant (e.g. NaPTAN Stops, NPTG locations, National Operator codes, TransXChange)?
4. How should fare data be grouped into XML documents – “granularity”?
5. How the data elements should be organised within an XML document?
6. What conventions should be used for naming documents containing UK Bus Fare data?

2.1 Relationship to European profile

The FXCP provides modular sub-profiles for (a) Stops (b) Timetables (c) Fares.

The Stop and Timetable parts of the UK profile are aligned with the common European Passenger Information Profile (EPIP) for exchanging stop and network data (TS 16614:PI Profile). One of the advantages of doing this is to make it easier for those software developers who need to support both UK and European profiles.

The UK profile is specifically adapted to use UK data sets such as NPTG, NaPTAN, NOC and TransXChange. It has a similar functional scope to the EPIP for stops and timetables, with a few attributes and elements added for optional use, it thus serves also as a guide to populating the European profile with UK data. Note that, while the entire content of NaPTAN is included in the EPIP, only a subset of UK TransXChange data is covered by it; sufficient to describe a simple timetable (and to define the network elements referenced by fares). A detailed explanation of the rationale and scope of a mapping of TransXChange for the FXCP is given in Part2 (FXCP-NT).

There is not yet a European profile for Fare data; but a similar approach is used to specifying the fare profile in PART3 to that in Part2, with the scope being targeted at common UK bus fares, as described in this document.

2.2 Basic and extended fare profiles

Fare structures and fare products vary greatly in their complexity; furthermore, some are very common in the UK and elsewhere while others are rare. While even very complex fare structures can be expressed in NeTeX, the majority of bus fares are more straightforward. The scope of FXCP categorises the features to be supported into two groups: A **basic fare profile (FXCP-FM1)**., and an **extended fare profile (FXCP-FM2)**. The main focus is on the basic features.

The advent of mobile technology is transforming both the way fares are delivered, and the products that are offered. The profile includes capabilities to describe advanced electronic fares.

2.3 Structure of this document

This Part1 (FXCP-IN) document is broken into a number of sections.

- **Section 1** – Introduction.
- **Section 2** – Overview and some background information on NeTeX. (For a fuller account of NeTeX see the NeTeX 1.1 specification documents.).

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- **Section 3** – Scope Describes a UK Bus Tariff Profile scope in terms of the different aspects of Bus fares that need to be supported. This section is intended to be understandable by the general reader who is familiar with public transport tariff concepts. It Includes examples

➤ **Section 4** – Introduction to technical principles

➤ **Section 5** – Examples of fares that illustrate the intended scope of the profile.

This document focuses on the specific application of NeTEx to represent UK bus fare data. A brief summary of NeTEx is given in the next section.

2.3.1 Credits

The profile has been developed under the sponsorship of the DfT & Traveline under a grant from the European Commission We are grateful for input from the UK bus community.

2.4 Presentation Conventions

2.4.1 Presentation Conventions for text

NeTEx follows certain conventions for presentation of technical terms with the text; in particular this helps to distinguish the use the same concept at different levels of abstraction (conceptual model, physical model, schema, etc). These conventions are given in detail in part2 but two key points are mentioned here:

- Transmodel conceptual model elements are shown in UPPER CASE, for example “LINE”, “SCHEDULED STOP POINT”, “TYPE OF TARIFF”. If required to be in the plural, a lower case is used; for example, “SCHEDULED STOP POINTs”, “TYPEs OF TARIFF”.
- Concrete XML elements from the NeTEx schema are shown in bold italic, *for example, **Line***. Compound names are camel cased without a space and are never pluralised, e.g. “**ScheduledStopPoint**”.

3 Overview of NeTEx

This section provides a very brief overview of NeTEx

3.1 Purpose of NeTEx

The NeTEx Exchange format is a CEN Technical Standard for exchanging passenger information between computer systems. It covers many types of multimodal data, including stops and lines, timetables and also fare products and prices (Figure 1).

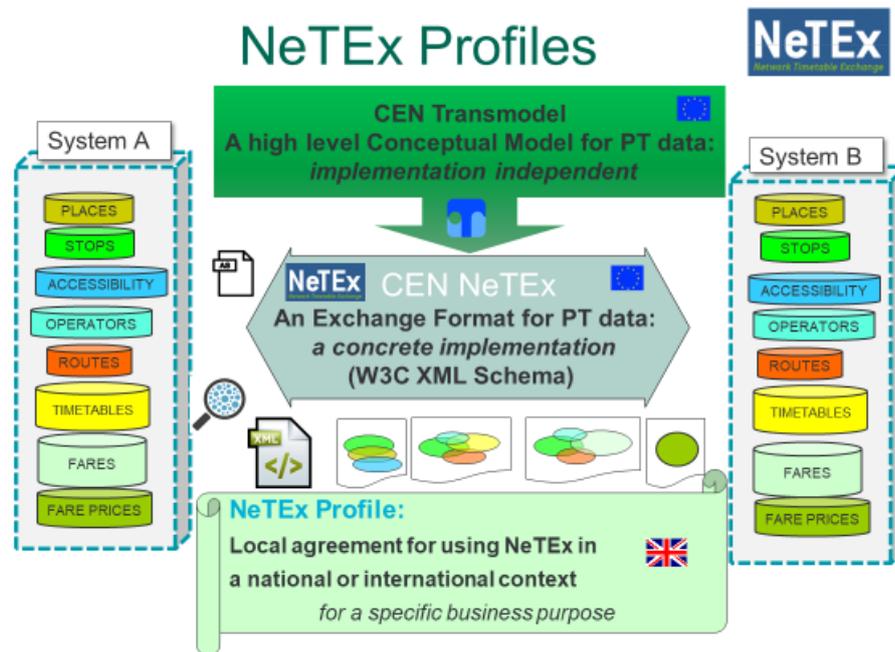


Figure 1 – Use of NeTEx to transfer data between Systems

Data is exchanged as XML documents that conform to a precise schema that can be used to check that the contents have the right data types and values and are self-consistent.

XML documents are electronic files where the start and stop of element is indicated with a tag. The allowed set of tags, as well as the rules for combining tags and validating the data are described by a schema (HTML, the tag language used to mark-up web pages is also perhaps the best-known example of XML use. There are different schemas with different tags for different purposes; and just as there is one for HTML, there is also one for NeTEx. XML can be contrasted with ‘flat file’ formats such as CSV (Comma Separated variables) which mark the start of each element with a comma. A schema gives a detailed definition of the meaning and structure of the content structure, making it possible to transform the data into other formats such as GTFS.

NeTEx is designed to allow the integration of data coming from different systems using different identifier systems. This is an essential capability for supporting an open data model that is “future proof”.

3.2 Use of NeTEx for Stop data

NeTEx includes elements with which to describe the stops and routes of a transport network for reference in timetables, fare tariffs, etc

These correspond to the concepts of Stop Point, Route etc found in NaPTAN and TransXChange.

The element may be associated with topographic places – equivalent to the Localities used in NaPTAN and NPTG.

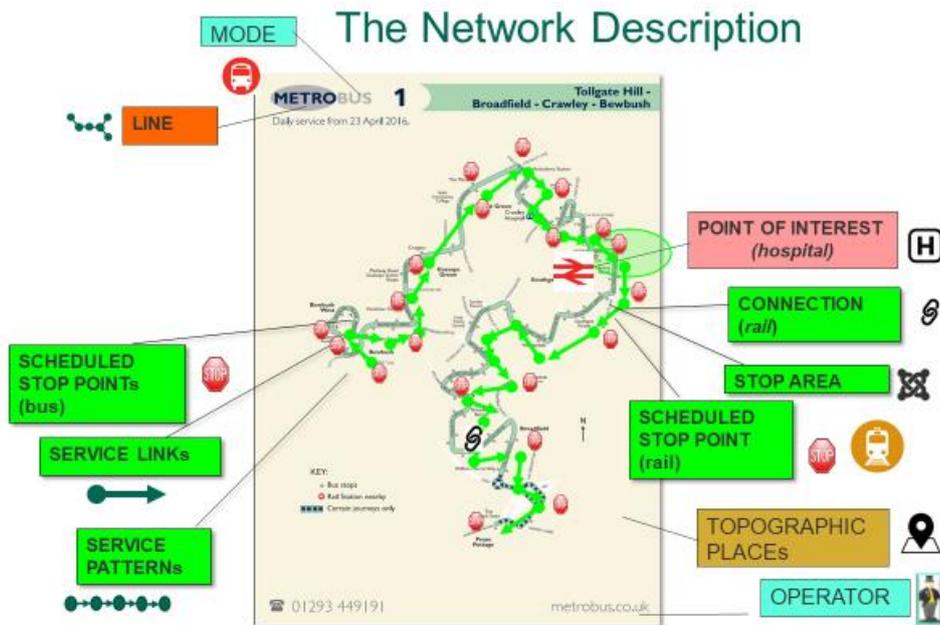


Figure 2 – Stops, routes and service patterns

3.3 Use of NeTEx for tariff boundaries

Fare systems may also define demarcations of the network, such as tariff zones (also called fare zones), and fare stages, that may persist independently of any particular fare product and which may be shared by many different tariffs. In some cases, these will be specific to an operator, in other cases the same zones will be shared by many operators.

NeTEx provides the means to define persistent tariff zones and fare stages and to relate them both to tops and to topographic localities.

The existing NPTG data set already provides definitions of PlusBus tariff zones for the entire country; the existing PlusBus zones, defining a zone around a station, can also be exchanged and referenced in NeTEx documents.



Metrobus 1 FARE ZONES

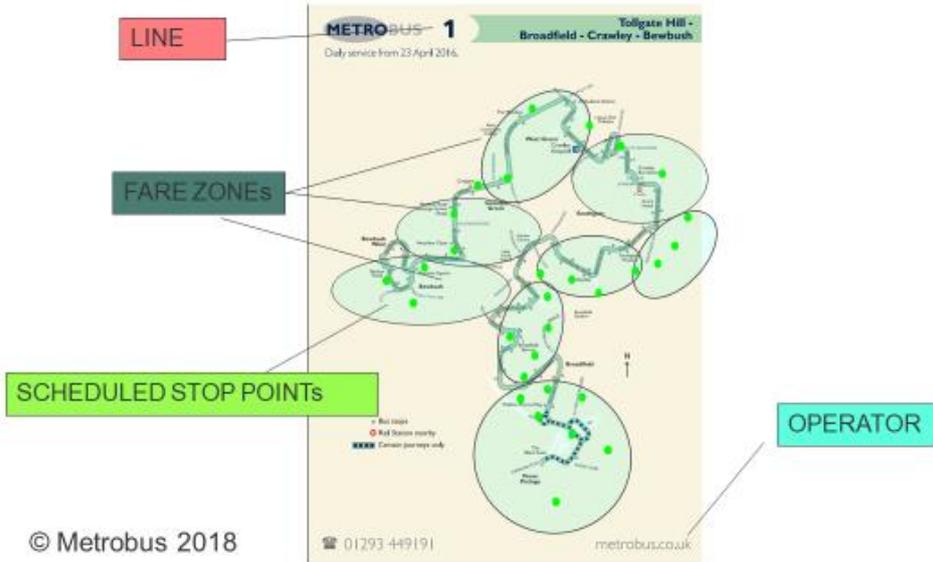


Figure 3 – Stops, zone sections

Nested Fare Zones - Metrorider & Metrovoyager

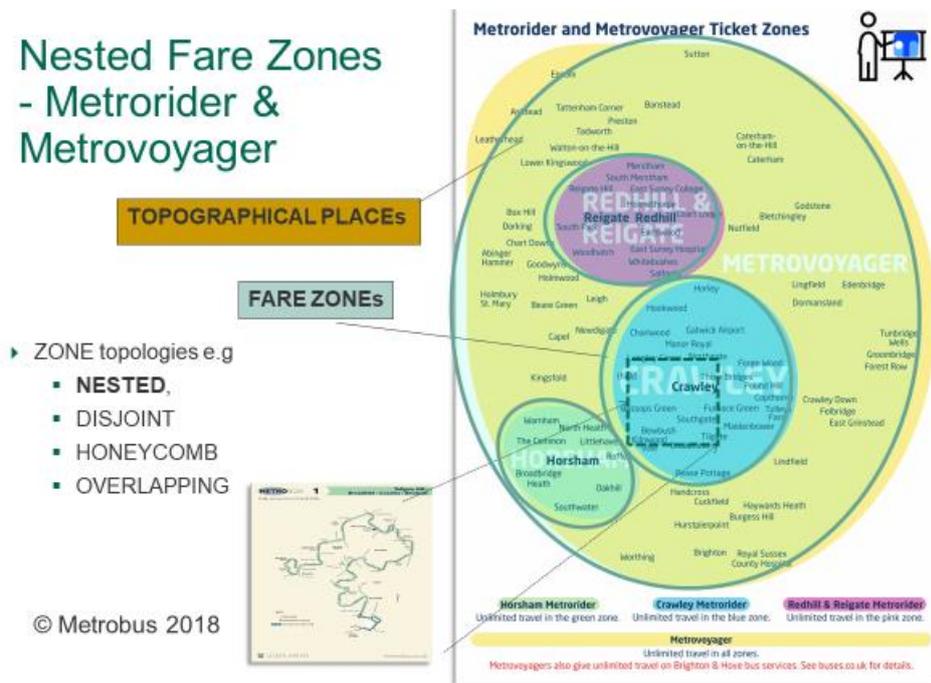


Figure 4 – Fare Zones

3.4 Use of NeTeX for Timetable data

NeTeX can be used to defined timetables for any mode of transport, including both absolute and frequency-based timings and many other features. Journeys may be based on shared journey patterns.

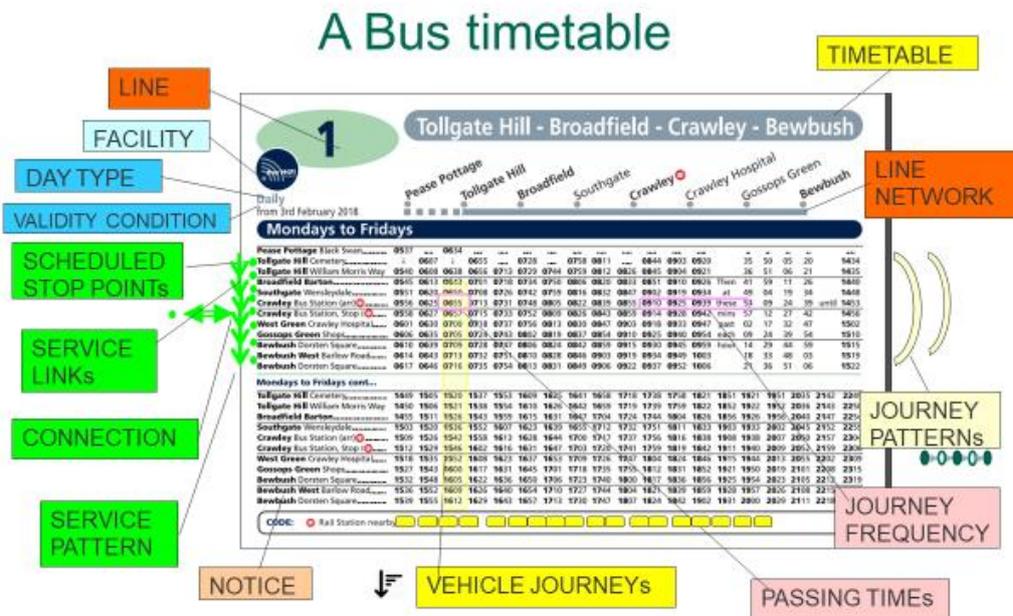


Figure 5 – Representing a bus timetable

The Transmodel representation of a timetable that is used in NeTeX separates out different concerns into separate layers that may be defined and reused independently for different purpose.

Thus, for example a service pattern might be used for both a timetable, for operation and for a tariff.

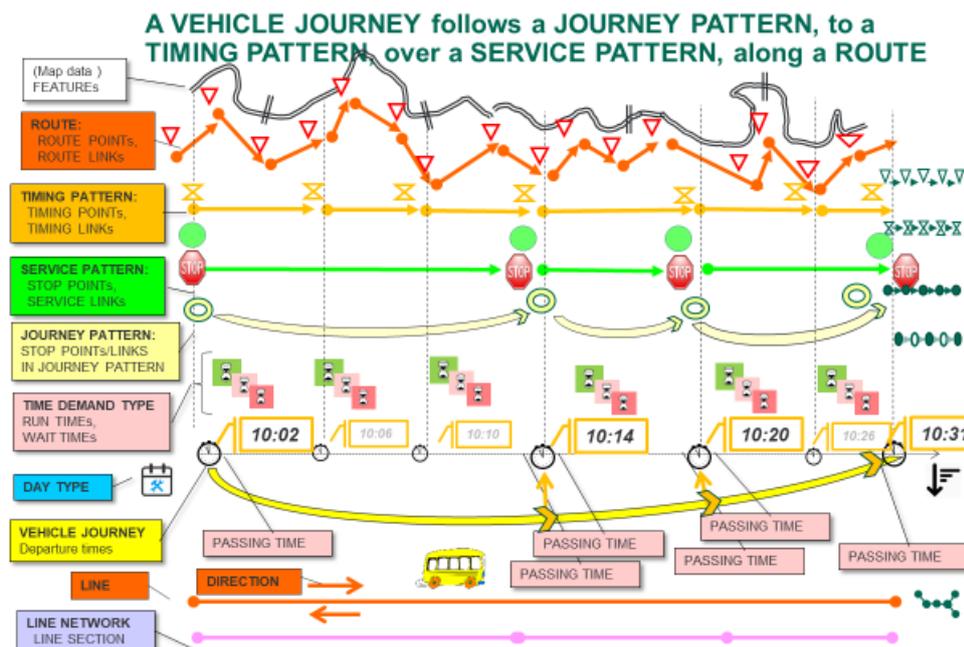


Figure 6 – Components of a bus timetable

There may thus be multiple journeys sharing the same journey pattern and timing patterns. This allows for an efficient (that is precise but compact) description of journeys and other components.

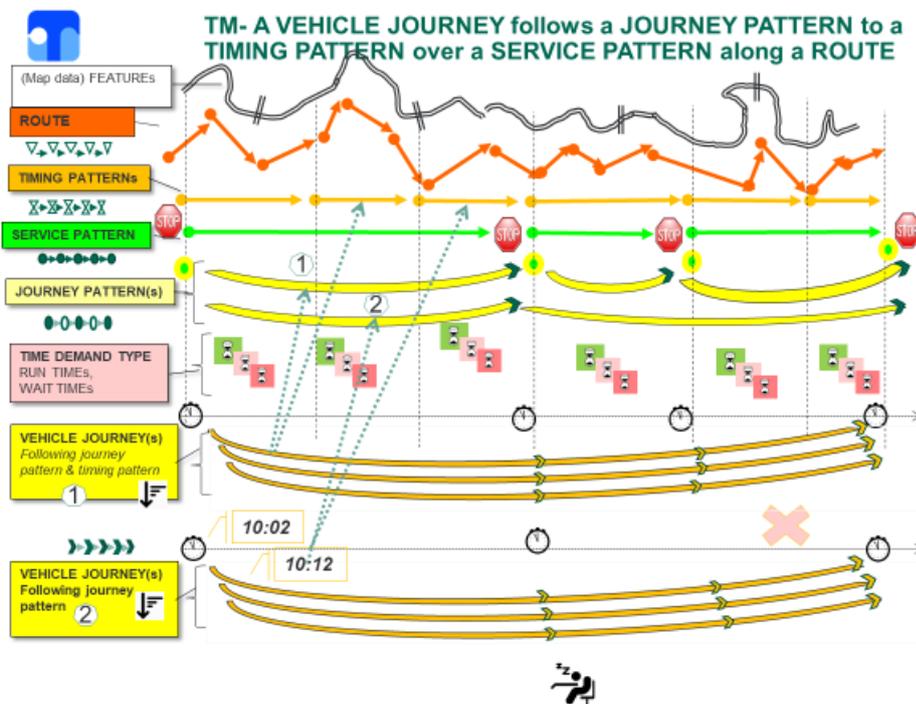


Figure 7 – Journeys making up a bus timetable

Some fare structures depend on timetable elements – for example particular journeys may be included or excluded from a tariff, or a fare may be specific to a particular journey; NeTex fare definitions can reference timetable elements just as they can reference stops. For most common bus fares however, timetable elements such as specific vehicle journeys are not directly relevant, however, certain components used in timetables, such as day types, may commonly also be used in fares.

3.5 Use of NeTex for Fare data

NeTex provides a rich representational model for describing both simple and complex fare products and their prices. Products are assembled from a set of low-level reusable components, building on other common data sets used to describe the stops, lines and timetabled services of a transport network or networks. Here we explain a few key principles of the NeTex representation before discussing the FXCP scope further.

3.5.1 Access rights and the NeTex representation

The essential characteristic of the NeTex “fare collection” data model is that it is based on **access rights** (i.e. service consumption rights), rather than on directly on products. An access right granted to a customer is a part of a service that a user is entitled to consume, and of which the service

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provider (or another organisation) is able to control the consumption. Familiar examples include; to ride between two stops on a service provided by a specific operator; to travel with a specific zone for a specified period of time, to make a short bus journey of up to three stops.

- Various access rights may be combined in order to form immaterial **“fare products”** (for example, a “single ride” granted by a fare product called “simple ticket” or multiple trips during one month” granted by a fare product called “monthly pass”), which are marketable sets of access rights.
- One or several fare products may be associated with a **“travel document”** and materialised (e.g. a paper single ticket allowing only a “single ride” or an electronic card containing various fare products).
- Combinations of fare products and travel documents are sold to customers as **“sales offer packages”**. Each sold package is part of an individual “contract” with a particular customer.

A variety of fare **prices** may be attached to a particular access right, each distinguishing a price that applies under particular conditions. The same access right may be sold in a wide range of marketable combinations, and access right can cover not just use of the transport network, but other consumable services such as meals, use of wifi, parking etc. The advantage of using the concept of an access right is that it allows the flexible composition of many different types of product from the same few components. Thus, it is possible to describe a price or a marketable package by starting from an access right description, but the opposite is not true, or at least would result in a great complexity.

In summary: the concept of an access right allows tariff elements to be treated as reusable components which can be assembled in different ways to create different products.

3.5.2 Defining Tariffs with NeTEx

Tariffs and Fare products are described in several steps (Figure 9), summarised as follows;

- a) The relevant elements of the transport network (stops, tariff zones, etc.) and timetabled services (e.g. specific journeys with fare restrictions, etc.) which may be used in a product are identified.
- b) A tariff structure is defined in terms of the spatial and temporal elements that are available to access, along with any other features or aspects of use that are subject to differentiated pricing (e.g. class of use, eligible types of user, peak or off-peak consumption, etc.).
- c) Sets of access rights (e.g. rights to use a zone, or travel between stops, etc.) are defined as validable elements.
- d) Products are defined that combine the sets of access rights with additional conditions such as commercial conditions for purchase and refund, etc.
- e) Products are combined into sales offer packages that described the ticket media on which the products are available along with any additional commercial conditions and the permitted sales channels.
- f) Prices for the allowed combinations of packages and product options are defined.
- g) Purchases of the products can be recorded as sales transactions, each recording a set of product choices and a purchase price. (This last step is outside of the scope of the FXCP).

There are uniform common mechanisms for organizing and versioning sets of data, and for describing common such as validity conditions, etc.

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A fundamental principle of the NeTEx approach is that prices are held separate to the elements that they price.

Another important principle is to reuse existing data elements from other layers wherever possible – thus for example, the same stop data is used for timetables and tariffs.

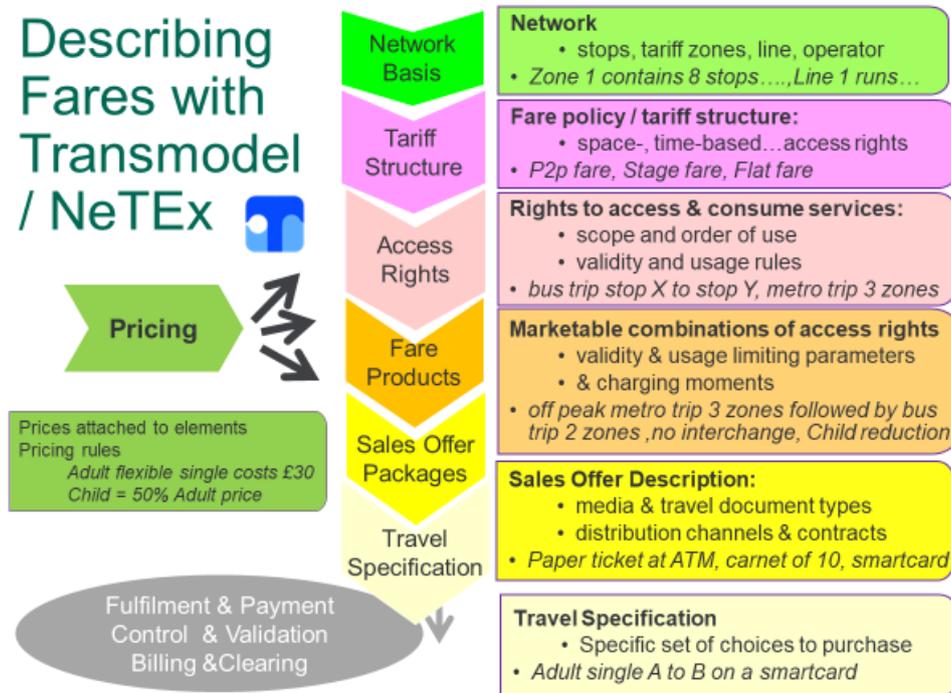


Figure 8 – NeTEx Fare Specification modules

For each of the different stages of defining a fare, NeTEx provides a set of reusable components. The **tariff & product definition will include all the possible alternatives that someone buying the product might select.** For example, *adult or child; peak or off-peak; zone 1 or zone 2* etc. (and as opposed say to having different products for different combinations of options).

When a customer wants to know the price of a given fare, a travel specification provides the set of specific choices (out of the available alternatives) for their intended consumption that determine the access rights, parameters and price of the fare. For example, 'An adult trip in zone 1', 'A child trip in zone 2' might represent different choice from the same product that has separate adult/child and zone1/zone2 options. Any set of specific choices can be given a price. This may either be done statically (i.e. by holding a separate price for every permitted combination), or by holding a base price for certain of the tariff components and apply a set of derivation rules to calculate the prices (For example child price is half the adult price).

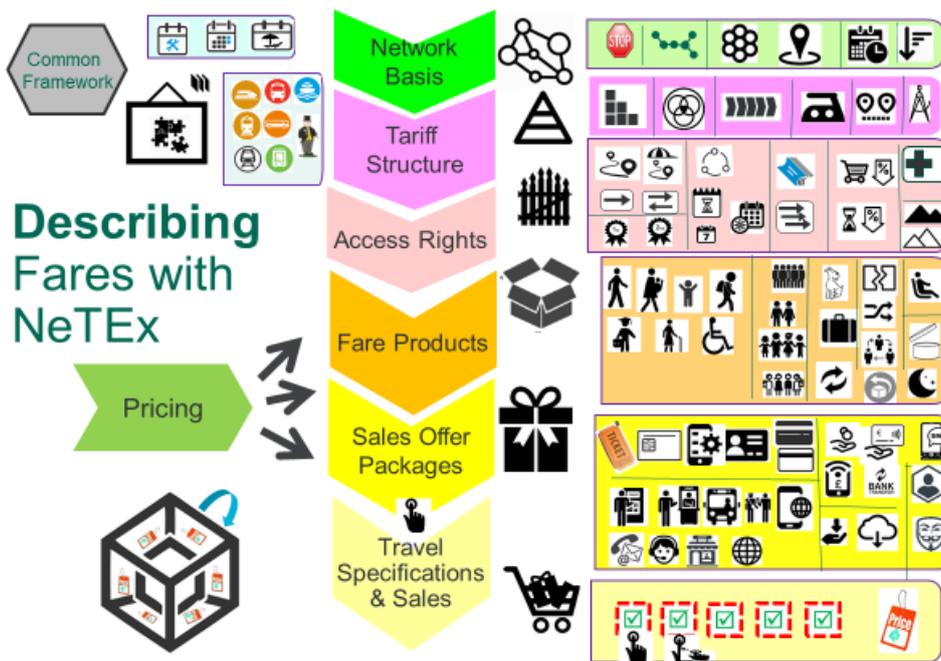


Figure 9 – NeTeX Fare Specification modules

3.5.2.1 Notation – Use of Infographics

Figure 9 above summarises the components of a NeTeX fare specification. The figure, as elsewhere in the presentation material, makes use of “infographics”; that is, a consistent icon is assigned to each concept and used to aid the understanding of complex material by readers.

3.5.3 Combining access rights

A further visualisation of how fares are specified with NeTeX components is given in the following diagram.

- A TARIFF is a set of FARE STRUCTURE ELEMENTs that define access rights in terms of network elements and other parameters.
- A VALIDABLE ELEMENT groups a set of FARE STRUCTURE ELEMENTs that can be checked (e.g. a bus ride in Zone 1).
- A FARE PRODUCT is the set of choices of elements and parameters that may be consumed as VALIDABLE ELEMENTS
- A SALES OFFER PACKAGE bundles up one or more FARE PRODUCTS

When a user purchases a product, they choose a permitted combination of specific options.

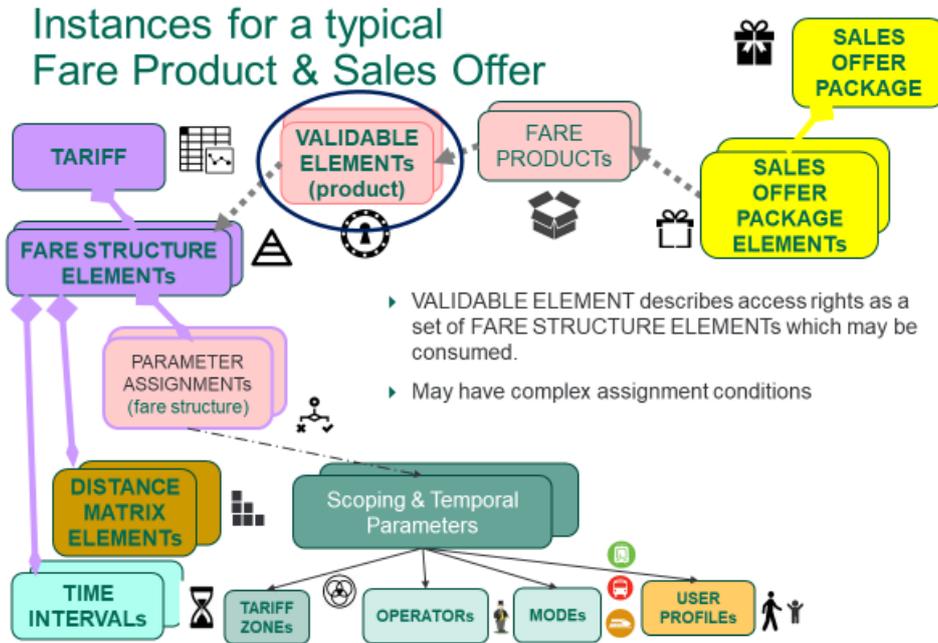


Figure 10 – Composing a product definition from fare structure elements

There may be further condition that apply to a specific VALIDABLE ELEMENT, FARE PRODUCT or SALES OFFER PACKAGE. These also can be described using the same mechanism of parameter assignment. NeTeX has a general-purpose VALIDITY PARAMETER ASSIGNMENT element that allows further complex conditions to be constructed from the simple elements of the network and fare structure.

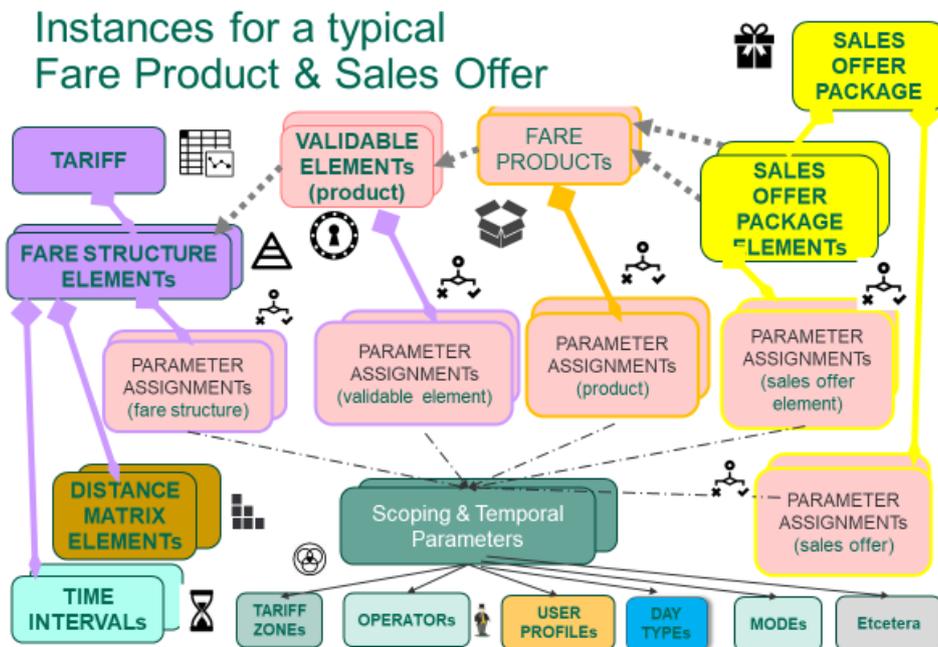


Figure 11 – Specifying complex conditions for a product

3.5.4 Combining Multiple Tariffs

Often multiple tariffs will apply to a route – or example (i) the simple single trip fares, (ii) zonal fares for an operator’s season pass products and (iii) tariffs marketed with other products such as *PlusBus*.

In particular, **where multiple tariffs and fare products are applicable to a route, NeTEx does not say which is “best”; it merely allows them all to be specified.** Typically, it is the task of journey planning or fare finding software (whether in an online service, ticket machine or station office on-line terminal) to decide which fares it wishes to show as available and in which order they should be presented. Various criteria are possible – cheapest for the user; most flexible for the user; most profitable for the operator; satisfying regulatory strictures, etc.

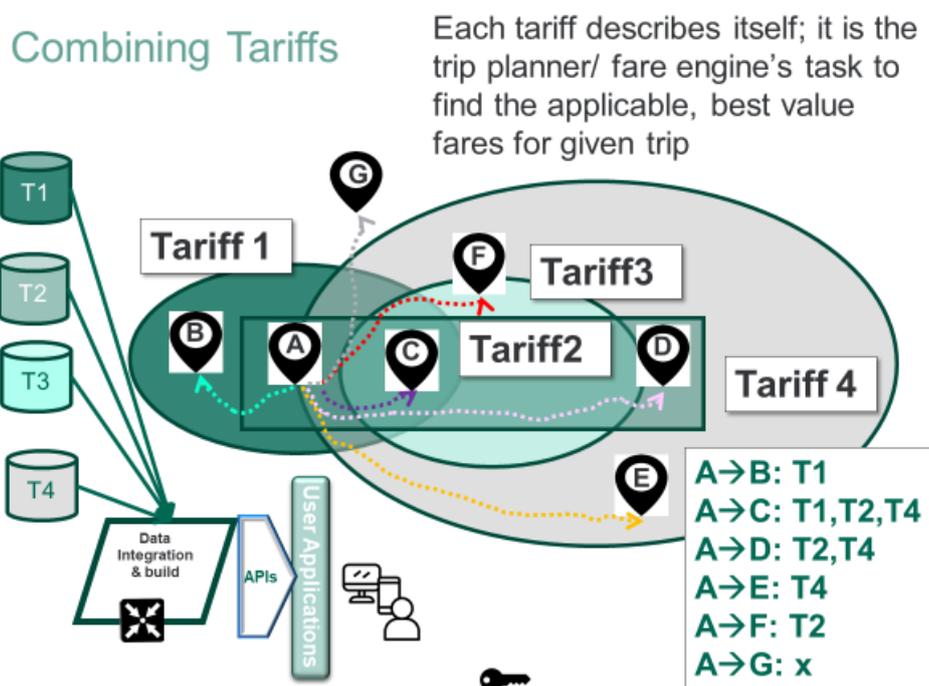


Figure 12 – Combining multiple tariffs

Each The fare structure, products and prices for each tariff should separately defined. They may reference common network elements, and share components (for example the pricing rules) but They should be packaged as separate XML documents that can be updated and distributed independently of each other.

3.6 Other Introductory comments

3.6.1 Relationship to Transmodel

NeTEx itself is based on the European reference model for Public Transport data, *Transmodel*, which sets out an extensive conceptual model of entities and relationships describing many different functional areas of passenger information and transport operation in addition to fares. Transmodel

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has recently (2016-2018) been revised to create an updated version 6.0, modularised into 8 functional parts. (Fare Management is part 5 of Transmodel)

- Transmodel as a conceptual model is concerned primarily with entities and relationships and prescribes only a basic set of attributes.
- NeTEx, as a concrete format, provides a detailed set of elements and attributes and makes a number of implementation decisions as to how elements are grouped and identified for exchange, as well as assigning data types, identifiers, etc.

NeTEx implements only a subset of Transmodel 6.0, including most of Transmodel Part 5 (Fare Management). Transmodel 6.0 includes additional features not yet implemented in NeTEx 1.1

Transmodel defines a generalised, implementation independent model for PT data, using a consistent vocabulary and is specified in UML, a standard software modelling language. NeTEx transforms this general model, firstly into a design model for a physical implementation, and then into a W3C schema. Among the key benefits of this “model driven” approach are; (i) a systematic, modular, design with a high level of reuse of components and; (ii) the ability to evolve the model readily to meet future needs.

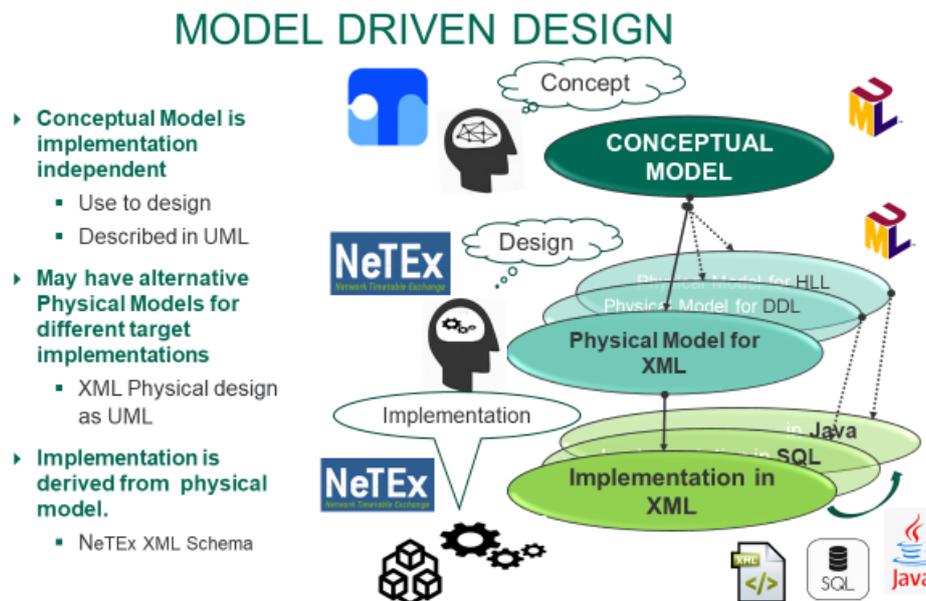


Figure 13 – Model driven design

3.6.2 Caution on terminology

Transmodel & NeTEx use the same systematic vocabulary of terms for specific domain concepts (LINE, NETWORK, VEHICLE, TRANSPORT MODE, etc). Often the usage will be straightforward and the meaning intuitive (POINT OF INTEREST, TIMING POINT, FARE ZONE, etc.).

- In some cases, these terms may appear non-intuitive or cumbersome (e.g. ACCESS RIGHT PARAMETER ASSIGNMENT, TEMPLATE SERVICE JOURNEY, SALES OFFER PACKAGE ELEMENT, etc) and it requires some effort to acquire a ready understanding of their precise meaning.
- In other cases, where the term corresponds to just one of several senses that a term has in common vernacular use (for example LINE, ROUTE, DIRECTION, TARIFF, FARE PRODUCT, etc), care should be taken to avoid confusion with the other vernacular senses.

3.6.3 XML schema technology

NeTEx uses W3C XML schema, a very well-established mainstream technology for describing data sets. W3C schema are used to describe documents for many of the most commonly exchanged data sets (HTML, Microsoft Office, etc) globally. Although relatively verbose compared to unvalidated formats (such as csv or JSON), it has a number of important advantages for the long-term management of complex data sets.

- **Data quality:** The schema provides a detailed description of the expected content which can be used to perform many basic validity checks for data quality and referential integrity automatically.
- **Flexibility:** The self-describing nature of schema documents makes it possible build applications that use data selectively, for many different purposes, and to evolve the schema without breaking backwards compatibility.
- **Machine-readable-** the self-describing format can be used to automate most of the legwork of implementation, building parser bindings that present the data to a program interface in a ready to use form.
- **Widespread adoption:** there are a wide range of tools and many people with the necessary technology skill sets to draw on.

3.6.4 Flat file representations of fare data

It is straightforward to transform a well-defined XML model into a flat table representation such as a spreadsheet or a csv file. Part of the success of the UK's NaPTAN format for stops has been due to the fact that it is also available in csv table format and as spreadsheets. It is envisaged that some consumers will also want to do the same for fare data, especially for price data. Some basic tables for this purpose are suggested in part 3, along with some principles for adding additional attributes and tables as needed.

3.6.5 Evolving NeTEx

NeTEx is designed to be modular and extensible under a uniform framework.

As a CEN standard, NeTEx has a process and active working group to maintain and enhance the standard to meet additional business requirements. CEN has an establish governance process to develop and enhance standards by a consensus process, with formal review and voting procedures, The UK's membership of CEN is distinct from its EC membership. NeTEx is managed by CEN TC 278 WG3 SG9

This profile and other projects are likely to identify additional requirements that can be added to NeTEx and Transmodel in future. Enhancements can include both additional functions, optimised encodings of existing function and clarifications as to use.

Successive releases of NeTEx are identified by a version number; this study is based on NeTEx 1.1, a recently completed revised and enhanced version of NeTEx due for final release in 2019.

3.6.6 Handling large date sets

Public transport data sets can be technically challenging to standardise, not only because they cover a complex domain, but also because they can be large, requiring consideration of the scaling implications for processing. Furthermore, data and subsets of data are often exchanged repeatedly between many stakeholders, necessitating a careful coordination of versions in order to achieve

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coherency (with necessary metadata to achieve this). The NeTeX framework includes mechanisms to assist with the management of large datasets including:

- ❖ **Frames:** A container mechanism that allows data to be modularised into coherent subsets. For example, “all the Season ticket products for a specific operator”, or “all the Network elements describing a line and its stops”. There are different types of version frame for exchanging different types of data (Figure 14).
- ❖ **Groups:** Groups of elements of a specific type may be grouped in named lists, allowing their repeated reuse as sets, and the assignment of common properties. For example, groups of sales offerings may be given shared properties, so that many similar products can be efficiently defined just by their additional properties.
- ❖ **Versioning and Validity conditions.** Fare management especially for multi-operator products will typically involve the exchange and aggregation of data from multiple stakeholders. There will be successive versions of data over time with updates having a specific validity period.
- ❖ **Systematic global identifiers.** In order to integrate diverse data sets a persistent, globally unique way of identifying elements of any types is needed. NeTeX employs a powerful uniform system of codespaces based on W3C namespaces.
- ❖ **Referential integrity checks:** Typically, a given data set will require a coherent set of elements all to be present in order to be usable. NeTeX makes extensive use of XML’s built in validity-checking mechanisms to validate internal cross-references within a document to ensure completeness. For external references to entities in other documents a uniform approach (including versioned references) is used that facilitates programmatic checking.

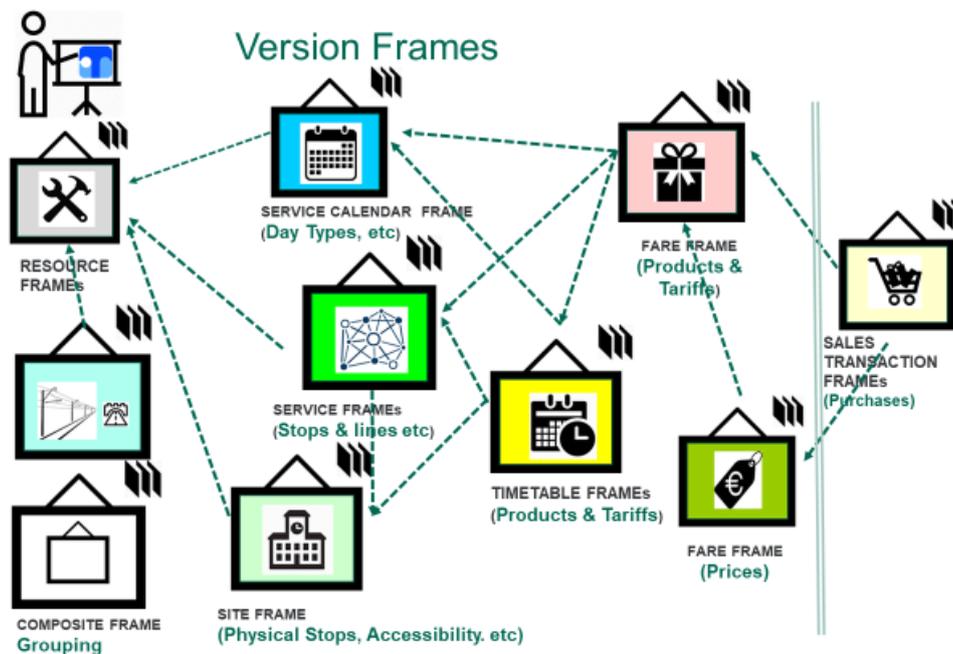


Figure 14 – Types of Version frame

3.6.7 Further information on NeTEx

Some introductory white papers are available at the NeTEx site

CEN

- EN 12896, *Road transport and traffic telematics – Public transport - Reference data model (Transmodel) Parts 1 to 9.*
- CEN/TS 16614-1 — *Network and Timetable Exchange (NeTEx) - Network description.*
- CEN/TS 16614-2 — *Network and Timetable Exchange (NeTEx) - Timing information.*
- CEN/TS 16614-3 — *Network and Timetable Exchange (NeTEx) - Fare description.*
- CEN/TS 16614-PI Profile — *Passenger Information European Profile*
- EN 15531-1, *Public transport — Service interface for real-time information relating to public transport operations - Part 1: Context and framework.*
- EN 15531-2, *Public transport — Service interface for real-time information relating to public transport operations - Part 2: Communications infrastructure.*
- EN 15531-3, *Public transport — Service interface for real-time information relating to public transport operations - Part 3: Functional service interfaces.*

DfT

- *NPTG & NaPTAN Schema Guide v2.5 2014*
- *TransXChange Schema Guide v2.5 2014*

4 Bus Fare Profile Functional scope

This part describes the functional scope for a UK Bus Fares profile.

4.1 Primary use case for UK Bus Fares

Fare and tariff data may be used in different stages of fare management and in many different ways. For example, to plan and set tariff structures and prices; to create published printed fare tables; to provision ticket machines; to inform journey planning engines of trip prices; to support validation and control of passengers, etc. The Transmodel and NeTEx specifications set out a number of potential use cases that characterise the requirements.

Note however that the UK Bus Fare Profile is concerned primarily with just one specific use case;

- ***To provide bus fare products & fare prices as distributed open data for third party use (by journey planners, fare calculation engines, etc.).***

The content of the distributed data should:

- Describe available fare products and their eligibility conditions for different types of user (adult, child, student, etc).
- Relate fare products to the bus network and the timetabled journeys so trip planners can compute fare products and fare prices for trips, show the tariff zones and the available products for an area, etc.

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- Describe available travel documents (printed tickets, smart cards mobile apps) and any tariff differentiation between them).
- Allow the separate exchange of prices independently of the tariff structures & products.
- Expose a justification of the fare (by distance, stage, etc)
- Support both machine readable & human readable representation of validity conditions and terms of carriage.
- Include information about how/where products can be bought.
- Include fares valid for specific and multiple operators.
- Be usable in cross border routes, such as in Ireland.

4.1.1 Standard fares versus best value fares

Passenger information applications using the bus fare data may be concerned to answer two quite distinct questions from passengers that differ substantially in their data requirements, viz;

- **What is the typical cost of a standard fare?** A useful indication of this can usually be obtained just by considering single use, one-way fares for adults and children that are available for a trip. Although cheaper fares may well exist, the standard fare sets a limit as to the likely cost.
- **What is the best value fare?** To answer this correctly, a knowledge of all the available products is needed (Including also returns, day passes, carnets, season passes, etc.) as well their particular restriction on use (peak, off-peak, eligibility, etc), all described in a machine-readable representation. Computation of the 'best' fare may thus also require additional consideration of the frequency and time of travel, the type of user and their eligibility for discounts, etc.

Answering the "best value" question is therefore a much more ambitious target for data suppliers. The 'basic' fare profile is focused primarily on the first case. The advanced fare profile includes features necessary for the second.

4.2 Work flows envisaged

XML Documents satisfying the UK Bus Fare Profile may be exchanged in many different workflows. In particular, they can be used for arbitrary peer-to-peer exchange as open data sent between any party. The same data may reach a consumer system by multiple routes and still need to be aggregated and integrated unambiguously; thus, it is important that element identifiers are stable and globally unique and that they can be managed through distributed processes rather than a central registrar.

Data is likely to be processed according to the following overall scenario (but others are not precluded).

1. Fare data will be originated by operators to complement their timetable data. It will reference stop (NaPTAN), location (NPTG) and line data elements already defined and reference by timetables encoded in TransXChange.
 - Operators will group route-specific tariffs in a similar manner to the way they group their TransXChange data, that is, by line/service. Thus, there will be one or more XML fare documents per TransXChange timetable, providing the tariffs for the line. This may include both single trip and season pass products.

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- Zonal products that apply to many different lines will be described in one or more separate documents for each operator for a specific network or part of a network. For such products, a definition of the zones will normally exist separately from the products themselves – and may be shared with other operators.
 - For certain products supported by multiple operators (for example, *PlusBus*, the nation bus add-on for rail), there will be a core definition providing a description of the common product and then additional definitions describing the exceptions for specific areas, supplied by each operator. A modular structure is needed to support such a workflow.
2. Operators will distribute their data by making it available on their sites, or by sending to one or more preferred aggregators.
 3. Price data can be stated separately from the definition of the products (even if they are included in the same document for the purposes of distribution); typically, the networks and products themselves are fairly static over time; prices may change more often.

A common workflow is for one party to act as an aggregator, collecting data from multiple stakeholders and validating and integrating it into a useful data set for other consumers. In practice, a workflow that allows peer-to-peer exchange can equally well be used for aggregation.

Data will include information as to data source, validity etc that can be used to manage documents. Certain common definitions will apply to all UK bus fare data. These definitions can be provided as part of the common fare profile (versioned so as to allow for future evolution.).

Workflows for fare data

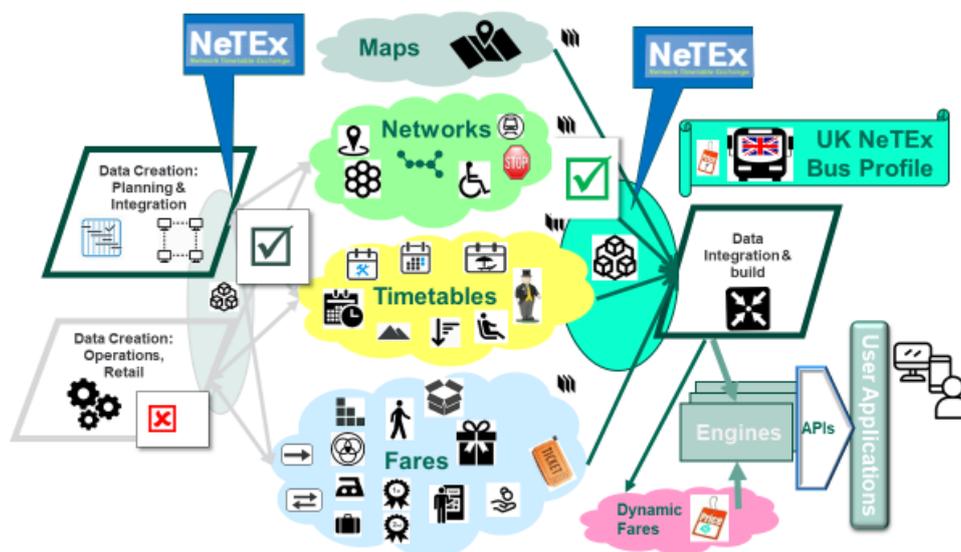


Figure 15 – Workflows for fare data

4.3 Overview of UK Bus Fare features

4.3.1 Summary of scope – Basic Profile

Domestic bus tariffs may be based on many different factors. The following sections outline each of these Commonly found features of UK bus tariffs may include the following;

- **Tariff Structures – Spatial & Network**
 - Arbitrary Point to fares (the most common).
 - Zonal fares. (zones may be variously disjointed, overlapping or nested).
 - Section or Stage based fares.
 - Flat Fares.
- **Tariff Structures – Temporal**
 - Validity period for making use of a ticket.
 - Maximum trip duration.
 - Different time intervals for passes (day, month year).
 - Start dates for season passes either variable or fixed to a day type or calendar day.
 - Fare Demand Periods: (Peak, off Peak, etc.).
- **Tariff Structure – Other factors**
 - Inclusion / Exclusion of specific lines.
 - Inclusion / Exclusion of specific journey run within a timetable.
 - Inclusion / Exclusion of specific operators.
- **Eligibility**
 - Standard products for any purchaser.
 - Concessionary products or discounts for different classes of user (Child, Senior, Student, Armed forces, etc.).
 - Accessible products allowing registered disabled travellers and their companions discounts.
 - Group tickets for more than a certain number of travellers travelling together.
- **Products & Sales Packages**
 - Short shop single trips.
 - Single trip (single or return) products for use at any time.
 - Single trip products with travel restrictions as to time, route etc.
 - Carnets or Multi-trip products.
 - Day Passes.
 - Carnets of day passes to be used in a certain period.
 - Season passes.
- **Conditions**
 - Conditions of use (variable time of travel, interchanging, journey breaks, etc.).
 - Conditions of purchase (exchangeability, refunds, Time of purchase etc.).
 - Distribution & Fulfilment conditions (ticket media, sales channels).
- **Units**
 - Prices will generally be in sterling, but may be in multiple currencies.

4.3.2 Modes in scope

The primary focus of the UK Bus Fares profile is on a specific transport mode: **bus**, that is local urban, suburban and rural bus services. It will also be applicable for tram and local ferry services that have similar tariff structures and fare products.

Although the profile can also be used for long distance (e.g. coach and rail) tariffs, the longer distance modes typically have some additional characteristics. In particular they may require a reservation of a seat. Since the fares are more expensive, the commercial conditions attaching to exchange and refund conditions are also of greater concern and tend to be more elaborate.

The profile may include products that are sold as add-ons to rail fares – in particular *Plusbus* fares, which offer a local day pass on zones around rail stations.

4.3.2.1 Exclusions

Additional features not found in bus products, but found in other modes such as rail are excluded from the profile. These can include complex peak/off peak conditions, routing restrictions, supplements (such as for luggage or upgrades to first class). The NeTEx specification has mechanisms to cover such features, but in the interests of simplicity, they are excluded from the of the Bus Fares Profile.

Exclusions include

- **Tariff Structures – Spatial & Network**
 - Distance based point-to-point fares (Though often the distances are not exposed to users who only see point-to-point fares computed by applying the distance tariffs to the distances).
 - Routing restrictions on point-to-point fares (including addition pricing for when particular routings are more expensive). Fares that are different in different directions (e.g. on circular routes).
- **Tariff Structures – Temporal**
 - Fare Demand Periods: (*Peak, off-peak, etc.*) where the period depends on the starting station
- **Tariff Structure – Other factors**
 - Classes of use.
 - Available facilities on the service (wifi, meal, etc.).
- **Products & Sales Packages**
 - Discount Right products given the right to purchase other products at a discount.
 - Usage Reward products giving the passenger a rebate or discount based on their previous consumption.
 - Supplement products such as seat reservations, couchettes, bicycle tickets etc.
 - Service products such as accompanying animals, transporting bicycles.

4.3.3 Efficiency of representation

The choice of the optimum model for the exchange of fare prices involves making a trade-off between complexity and size; one may choose to exchange either a small data set of parameters requiring a complex set of calculations to interpret, or a large data set requiring a simpler processing by the consumer.

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Although the simplest tariff structure for a consuming system to interpret is a point-to-point fare, and although other tariff structures can be processed to transform them into a table of point-to-point prices, such an approach does not scale for large numbers of stops, and so limiting the profile to a single point-to-point tariff structure has been ruled out as a means of simplification. Some sizing examples, illustrating the dimensions of data sets for of different tariff structures are given in part3).

4.4 Round up of UK Bus Tariff Features

In practice, although there is considerable variation in how fares are described and presented to the public, only a subset of all the possible combinations of PT tariff structures, products and conditions are typically found in UK bus tariffs.

The following section summarises the main tariff features suggested for inclusion in a UK Bus Fare profile.

Not every tariff feature is found in combination with every possible common product. Figure 16 introduces the main combinations of features commonly found in UK bus fares. It shows separate groupings of different individual **Trip** and repeated use i.e. **Pass** products, collated against a number of different tariff structure (Flat, point-to-point, named zones, and unit section/ stage count), as well as whether they are likely to be offered with time of travel restrictions or with group tickets.

Basic UK Bus fare products

Access rights		Tariff Structure						
Type of Product	PREASSIGNED FARE PRODUCT	Flat	Point to point	Named Zones	Zone/ Stage Count	Peak / Off Peak	Group Ticket	Temporal Conditions
TRIP ("single ride")	Short hop	✓	✓	✓	✓	?	-	No break
	Single trip	✓	✓	✓	✓	✓	✓	Has use by date?
	Time-limited ("Hopper")	-	-	✓	-	✓	✓	Max trip duration, Can interchange
	Period Return	✓	✓	✓	-	✓	✓	Has use by date?
	Day return	✓	✓	✓	-	✓	✓	Must use same day
PASS	Day pass	-	-	✓	-	✓	✓	1D (elapsed or calendar)
	Termtime	-	?	✓	-	-	-	Use during term 1Y
	Season pass	✓	✓	✓	-	-	✓	n x D,W,M, 1Y

Figure 16 – Common Product / Tariff combinations

For convenience and to save transaction costs, multi-trip products are also found. Such carnet products bundled up multiples of trips or day passes.

Carnets: Multi-trip / Multi-pass offers

Access rights		Tariff Structures		
Type of Product	FARE PRODUCT (AMOUNT OF PRICE UNIT)	Quantity	Related tariff structure	Temporal Conditions
CARNET	Multi-trip	✓	Any individual Trip	Trips have use-by date Trips can be time limited
	Multi-Day pass	✓	Day Pass	Passes have specified duration Passes have use-by date

Figure 17 – Multi trip /Carnet Tariff combinations

4.4.1 Relating the features to NeTeX elements

Each of the tariff aspects correspond to specific components in the NeTeX Model; some relevant NeTeX components are noted in each section so as to give an indication as to how the fare is encoded as a NeTeX document.

- ❖ A clover leaf bullet is used to indicate the relevant NeTeX elements. These can be ignored by non-technical readers

☞ A manicule (pointed index finger) symbol is used for specific UK Bus profile guidelines.

4.4.2 Commonly found Tariff structures in UK bus

The fare products given above can be based in a number of different possible tariff structures; point-to-point, zonal, flat, etc.

In general, we may distinguish between those aspects of tariffs representing *access rights*, that is, the rights to consume different types of public transport service, from those of *usage parameters* which further moderate or qualify the consumption of services governed by the access rights.

Table 1 (below) and Table 3 (later) show common spatial and temporal access right concepts respectively. Usage parameters are discussed later below.

4.4.2.1 Network access rights for tariff structures for UK Bus fares

Name	Description	Comment	Note/example
Point-to-point (P2)	Access right is to travel between two named points.	Explicit: Separate prices (or price groups) are given for each named Origin and Destination Pair.	Widespread – e.g. UK standard fares. Access in different directions may have

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		<ul style="list-style-type: none"> ❖ Represented in NeTEx by a DISTANCE MATRIX ELEMENT. <p>Where the network has multiple routes, or operators there may be constraints by route and or by operator.</p>	different price (e.g. on circular route).
Zonal 	Access right is to travel in named zones.	<p>There is an absolute price for each zone or zone combination. The specific origin and destination zones determine the price.</p> <ul style="list-style-type: none"> ❖ The tariff zones are represented in NeTEx by a TARIFF ZONE or FARE ZONE, which can be used to assign stations to one or more tariff zones. ❖ Each Zone O/D pair is represented in NeTEx by a DISTANCE MATRIX ELEMENT. 	
Stage Counting 	Access right is to traverse a certain <i>number</i> of stages or zones.	<p>Each stage or zone has a unit cost associated with traversing it. the number of zones traversed is used to determine the price.</p> <p>A given stop may be in several zones (e.g. also a 'near to' zone) so as to smooth the prices of short trips. (A stop may be assigned to a FARE ZONE, or to a specific FARE SECTION within a SERVICE PATTERN).</p> <ul style="list-style-type: none"> ❖ Represented in NeTEx by one or more GEOGRAPHICAL INTERVALs, where the unit is a zone or section. ❖ A GEOGRAPHICAL INTERVAL PRICE may be given to each interval. 	
Flat Rate 	Access right is regardless of distance or time.	<p>Price is fixed. Commonly used for supplements.</p> <ul style="list-style-type: none"> ❖ Represented in NeTEx by some form of FARE PRODUCT PRICE associated directly with the supplement product. 	Bicycle fees, Airport Express fare, some night trains.

Table 1 – Common Network access aspects of Tariff Structures

4.4.2.2 Exclusions from the UK fare profile

A specific exclusion of the FXCP are “mileage” distance fares. Although classical rail, and some bus tariffs were often distance based, true mileage-based pricing is not now common in fare systems (at least as presented to users). Most so called ‘distance based’ fares are not directly based on mileage. Although they vary according to the distance travelled and are usually progressive – that is, the price gets cheaper the more units are consumed – they do not directly relate to the distance in miles;

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rather the route is broken down into a number of roughly equivalent stages and a unit price per stage is used.

Name	Description	Comment	Note/example
Distance 	Access right is to travel between two named points, the pricing being based on a shortest path distance through the network.	<p>Distance Based: A table of distances and a price per kilometre is given.</p> <p>This can be used to compute a P2P price based on the timetable distance.</p> <ul style="list-style-type: none"> ❖ Represented in NeTEx by a set of GEOGRAPHICAL INTERVALs with GEOGRAPHICAL INTERVAL PRICES that can be used to price the distance from a DISTANCE MATRIX ELEMENT. 	

Table 2 – Common Network access aspects of Tariff Structures

UK  ✖ Distance based fare are not included in the NeTEx profile

4.4.2.3 Illustrating spatial factors for tariff structures

This section presents simple visualisations of different spatial concepts distinguishing the different structures found in UK bus fare tariff.

4.4.2.3.1 Flat tariff structure

Error! Reference source not found. shows the price / distance graph for a **flat** tariff system, where the price is set regardless of distance.

Flat fares are commonly used for supplements such as dog tickets, or for simple products where there are no further options such as a shuttle between two points.

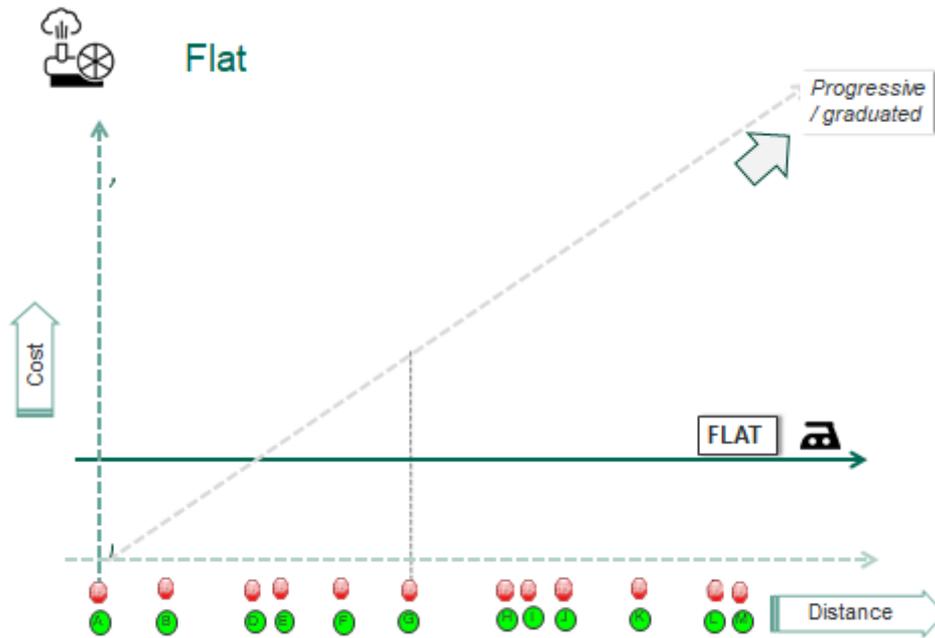


Figure 18 – Flat tariff structure

- ❖ In NeTEx, such tariffs are typically represented simply by associating a price with the product or product element or parameter that is subject to a flat rate.

Scaling is trivial. One price and one element being priced.

4.4.2.3.2 Point-to-point tariff structure

Figure 19 shows the price / distance graph for a point-to-point tariff system where the price between any two points can be set arbitrarily. While the pricing is usually progressive – i.e. increases with distance – it does not have to be, and there may be anomalies to improve yields or discourage use of congested sections of the network. A zone-to-zone pricing is similar in concept, but reduces the number of prices needed by aggregating stops into zones.

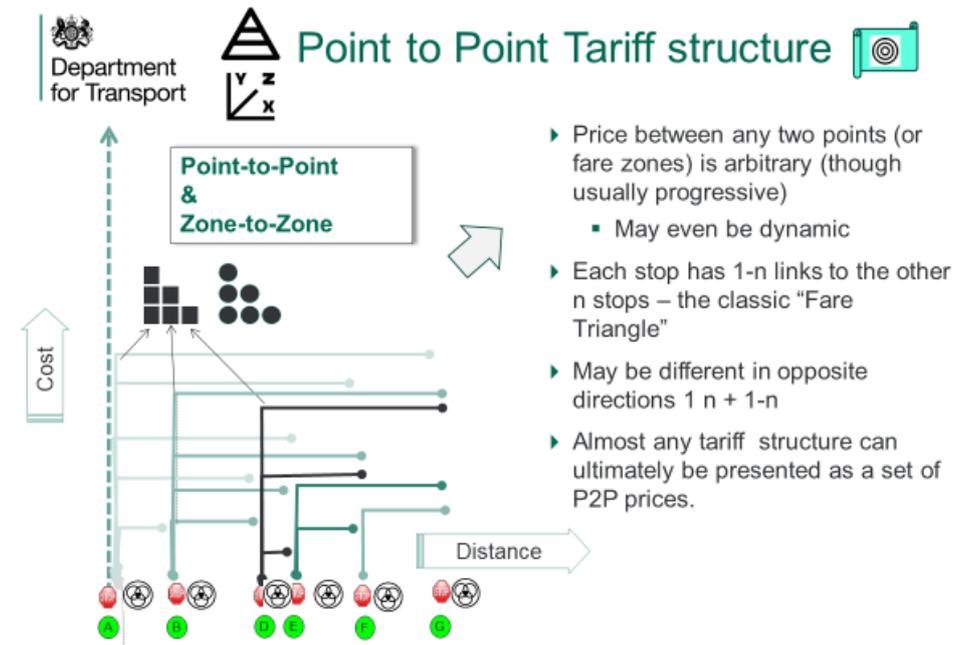


Figure 19 – Point-to-point based tariff structure stops,

If there are large number of stops, a point-to-point system may lead to an unmanageable number of prices (See discussion of data set sizes in part3). The use of zones can dramatically reduce the number of elements, so zone-to-zone tariffs are more commonly found.

- ❖ In NeTEx, point-to-point tariffs are typically represented by a set of DESTINATION MATRIX ELEMENTs, each representing the possibility of travel between two points. Prices may be associated with these origin/destination pairs. Where multiple routings are possible. The routing(s) may be indicated by one or more SERIES CONSTRAINTs, INTERVALs, each with a price.
- ❖ Some online systems may apply dynamic pricing, such that individual train journeys are each priced differently in real time. Prices can attach to individual SERVICE JOURNEYs that follow JOURNEY PATTERNs that relate to the destination origin and destination.
- ❖ There may be many different tariffs that apply to the same DESTINATION MATRIX ELEMENT.
- ❖ A tariff presented to the user as a point-to-point price may actually be computed from another tariff structure (distance, zonal, etc), applying rounding, tax etc.

UK NPTG NaPTAN points can be used to identify stops.

Scaling depends on the number of O/D pairs, since each O/D must indicate its own specific price, even if price bands are shared between O/Ds with similar distances. Both the data set to describe the O/D matrix, and the accompanying prices may be large data sets since the scaling is non-linear:

- Point-to-point: Assuming prices are the same in both directions, and the user doesn't travel from and to the same stop, scaling depends on a square function of the number of stops given by $[x= S_n(S_n - 1)/2]$.
- Zone-to-zone: Assuming prices are the same in both directions, and the user may also travel in a single zone, scaling depends on a square function of the number of zones $[x= S_n^2/2]$. However, if zones are nested there may be fewer combinations to price.
- The size of the data set to describe the zones may also be quite large Each zone needs to indicate which stops are in it, so the size depends also on the number of stops and how many zones they each belong to on average. Thus scaling of the zone data set is linear on the number of zones and stops $[y=Z_n + (S_n \times M)]$.

4.4.2.3.3 Zonal tariff structures

Figure 20 shows relative pricing of zones of a zonal tariff system. Again, the pricing is usually progressive – i.e. increases with zone size and so travel distance – but does not have to be so. Zonal systems may be arranged according to different topologies – e.g. disjoint, nested, overlapping, etc.

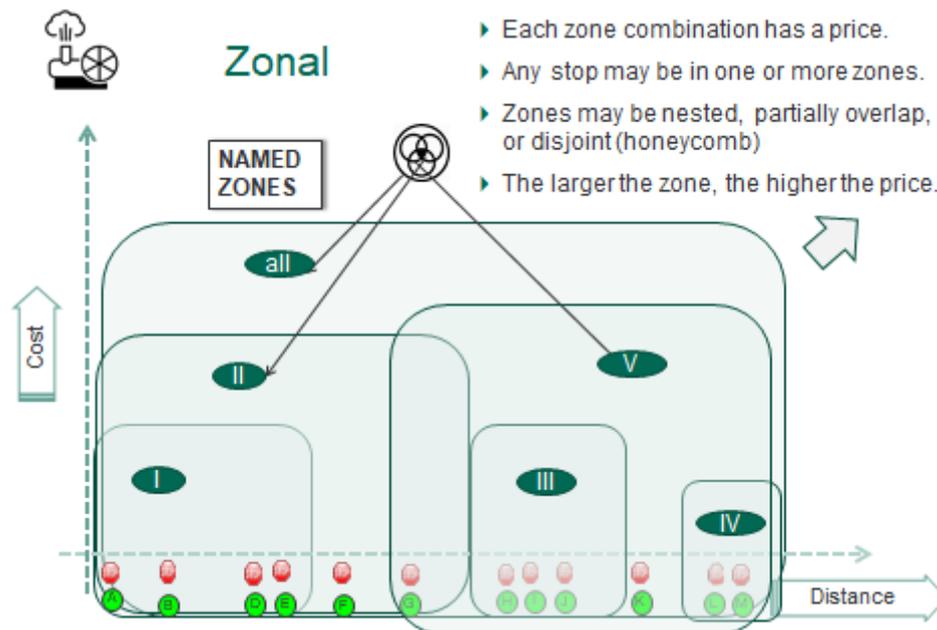


Figure 20 – Zonal tariff structure

- ❖ In NeTEx, FARE ZONES (a specialisation of TARIFF ZONE) are used to describe groups of stops making up a zone. DESTINATION MATRIX ELEMENTs can be used to specify the allowed transitions between zones and the prices attached to them.
- ❖ A stop may be in more than zone; it is up to the trip planner to find the cheapest zone to use for a given trip.
- ❖ In most fare systems the zones are predefined by the transport operator. Note however that some modern account-based systems for multimodal urban fares in Europe now allow the user to define a “personal zone”; a centre point is chosen and then stops within a given radius may be added. The tariff structure is thus based on the zone size applied to a radius, rather than on any specific predefined zone. This can be represented in NeTEx by a FARE QUALITY FACTOR giving the permitted ZONE size or sizes. A process is needed to build and store the customers personal zone and associate it with their account and travel document. In other respects, it can be regarded as a normal zone tariff, and is cited here as an example of how the NeTEx model can be used flexibly to address future needs.

UK🇬🇧 NPTG NaPTAN points can be used to identify stops for zones.

UK🇬🇧 NPTG PlusBus zones can be used to identify bus zones for the *PlusBus* product.

Scaling: the number of prices depends on the on the number of Zones. $[x=Z_n]$

The size of the data set to describe the zones may also be quite large Each zone needs to indicate which stops are in it, so the size depends also on the number of stops and how many zones they each belong to on average. Thus scaling is linear on the number of zones and stops $[y=Z_n + (S_n \times M)]$.

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4.4.2.3.4 Zonal / Stage / Section count tariff structures

Figure 21 shows a price / distance graph for the tariff steps of a unit fare system, in which the network is divided into similar sized zones or sections and a unit price is assigned for use of a single zone or section. The price of travel then depends uniformly on the number of zones or sections consumed.

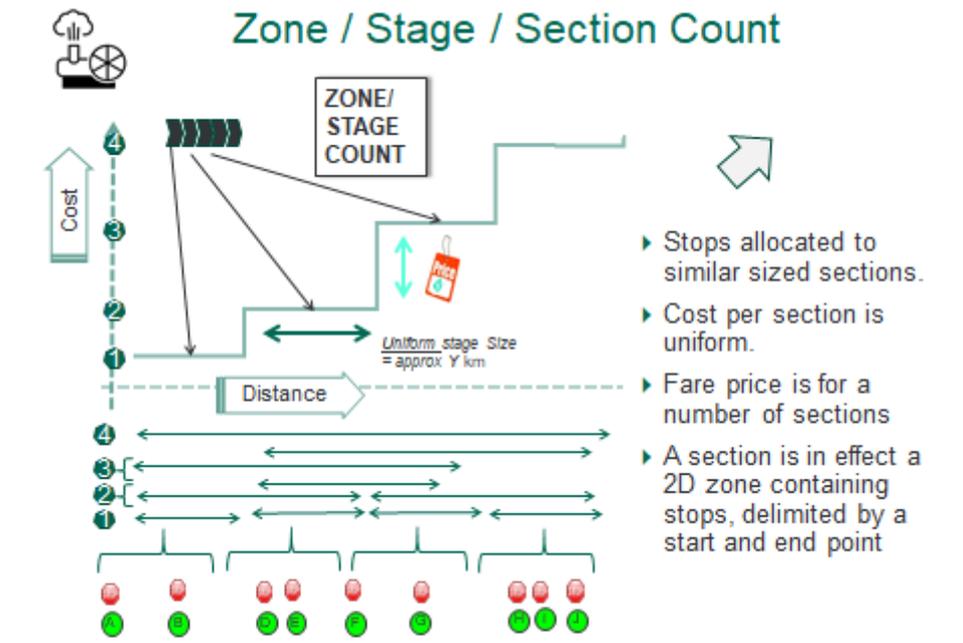


Figure 21 – Zone / Stage count tariff structure

- ❖ In NeTEx, sequences of stops can be described as a FARE SECTION. FARE ZONES can also be used to describe groups of stops making up a zone. A GEOGRAPHICAL INTERVAL can be used to define a number of sections or zones and a price attached to it.
- ❖ A stop may be in more than section or zone; it is up to the trip planner to find the cheapest section to use for a given journey.

Scaling: The size of the data set needed to represent the prices is typically small and depends only on the number of interval steps (say between 3 and 10).

A data set is also needed to describe the sections or stages, the size of which depends on the unit.

- Unit stop: the number of stops consumed can be derived simply by counting stops along the route as given by the service pattern. (i.e. no extra data set needed).
- Unit section: scales according to the number of sections / stages that need to be represented (itself a function of the number of stops and the frequency of stages per stop along a route). Thus scaling is linear on the number of stages [$y=S_n/F$].
- Unit zone: scales according to the number of zones. Each zone furthermore needs to indicate which stops are in it, so the size depends also on the number of stops and how many zones they each belong to on average. Thus scaling is linear on the number of zones and stops [$y=Z_n + (S_n \times M)$]

4.4.2.3.5 Distance based tariff structure

Figure 23 shows a price / distance graph for a **distance** tariff system where the price is a progressive function of distance. In practice the line would (a) probably be curved downwards to the right, as

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prices would be reduced for longer distances; also, (b) be slightly stepped to reflect rounding up and down to amounts convenient to handle in a specific currency. The units of distance may be actual kilometres, or a notional fare distance that is slightly different from the actual distance, or even some arbitrary unit.

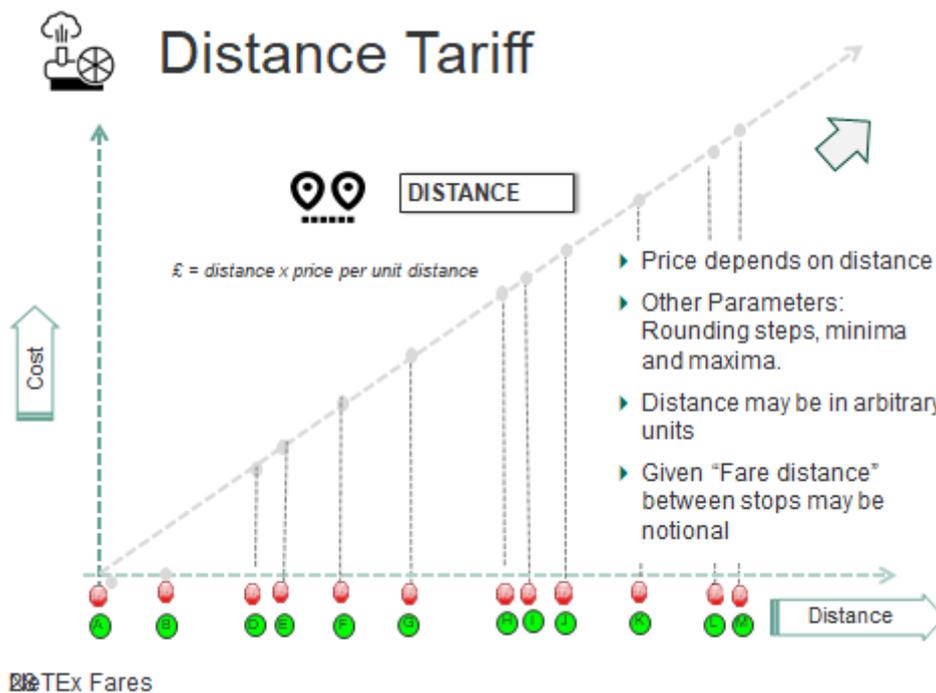


Figure 22 – Distance based tariff structure

- ❖ In NeTEx such kilometre distance tariffs are typically represented by a set of GEOGRAPHICAL INTERVALS, each with a price. Distances between stops, as say stated by a set of DESTINATION MATRIX ELEMENTS, each describing an origin/Destination pair, are used to compute the price between any two stops.

UK NaPTAN points can be used to identify stops.

Scaling: The size of the data set needed to represent the prices is typically small and depends only on the number of interval steps, which in turn is likely to depend on the maximum distance covered, but probably ranges between three and eight intervals.

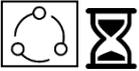
However, a distance-based fare also requires a means of specifying the distance, i.e. a stop-to-stop link distance describing the route topology. Thus scaling is linear on the number of links required to describe the network, which itself scales on the number of stops [$y = S_n - 1$]. The links may already exist for other purposes, e.g. to define the timetable.

4.4.2.4 Temporal fare aspects of Tariff structures

Temporal constraints may apply the tariff structure (Table 3). Some of these can be regarded as fundamental to the access rights of the tariff structure, for example the period of a season pass, or the duration of a trip, or when travel may take place; others may apply to ancillary factors such as the commercial conditions attached to the fare, for example, the purchase window within which the ticket may be bought. In both cases different prices may attach to different conditions.

Nature	Description	Comment	NeTEx

UK Bus Fares Profile

<p>Pass duration (Access Time Limited)</p> 	<p>The traveller may have the rights access the network for a specified period – ranging from a day to one year</p>	<p>As in day and season passes. Prices typically depend on the duration, with discounts for longer periods.</p> <p>For a day pass, the start and end times may be fixed (the fare day) of variable (from the time of purchase.</p> <p>For a season pass the start day and duration may be fixed (e.g. Monday for seven days, or the 1st of the month for one month) or variable.</p>	<p>❖ Available intervals are represented in NeTex by a TIME INTERVAL</p>
<p>Trip duration (Access Time Limited)</p> 	<p><i>Once started the passenger may be required to complete an individual trip within a certain time</i></p>	<p>In a zonal system, different time intervals may be offered at different prices (e.g. 1 hour, 2 hours, 3 hours, etc.), in effect constituting a form of distance-based fare.</p> <p>In a point-to-point system where the destination is already fixed, the time represents the maximum time allowed to make the trip – relevant in particular if journey breaks are allowed.</p>	<p>❖ Represented in NeTex by a TIME INTERVAL</p>
<p>Use by date</p>  <p>(Usage Validity)</p>	<p>Once purchased. the product may be required to be used within a certain period.</p>	<p>Applies mainly to trip products – most standard tickets must be used within a certain time.</p> <p>A return trip may have to take place within a certain time after the outbound trip.</p>	<p>❖ Represented in NeTex by a USAGE VALIDITY PERIOD.</p>
<p>Time of Travel (Fare Demand) limited</p> 	<p>Travel may be limited to travel only at certain days or times of day.</p>	<p>Standard tickets can be used anytime, other tickets may be restricted to various Off peak timebands and or day types.</p> <p>There may be different time band bands for different directions of travel.</p>	<p>❖ Represented in NeTex by a FARE DEMAND FACTOR.</p>
<p>Purchase Window</p> 	<p>The product may only be available a certain in advance or up to a certain time before travel</p>	<p>Discount and group products in particular tend to have limits as to when they can be purchased. These may vary by distribution channel and period. There may for example be different prices associated with purchasing or changing a fare within a given time.</p> <p>Different times may apply to initial purchase and renewal.</p>	<p>❖ Represented in NeTex by a PURCHASE WINDOW.</p>

UK Bus Fares Profile

<p>Post-sales conditions</p> 	<p>The time conditions as to when a product may be modified, exchanged, refunded, renewed, etc.</p>	<p>Limits may apply to the period in which exchanges and refunds are allowed. For passes</p>	<p>❖ Represented in NeTEx by an EXCHANGING, or RETURNING.</p>
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Table 3 – Some temporal concepts applying to fares

4.4.2.5 Illustrating temporal factors for tariff structures

This section presents visualisations of different temporal concepts found in UK bus fare products in order to distinguish between the different possible usages.

4.4.2.5.1 Basic temporal elements for a single trip

Figure 23 introduces the simple case of a single one-way trip, shown as an arrow indicating a directional traversal of space over time in a specific direction (outbound is up, return is down). Basic temporal concepts relevant to the access rights include:

- The **usage validity period** within which the product must be used; this may be relative to the original date of purchase or otherwise, such as the day of activation for travel. Choice of a period for a product will be subject to rules as to **when the journey may start**. The start time may be **fixed** (typically by being tied to the choice of a specific journey) or **variable**, the same ticket, allowing the user to take any train within the usage validity period (as opposed to requiring an exchange and a reissue of another ticket for a different date).
- The **maximum permitted trip duration**, once the journey is started. For how long the user may travel. (Applicable mainly in zonal systems where the user may travel anywhere by any route). A tariff structure might allow several different intervals at different prices.
- The **purchase window**. The period before (and if onboard sales are allowed, during) travel within which the product can be purchased.

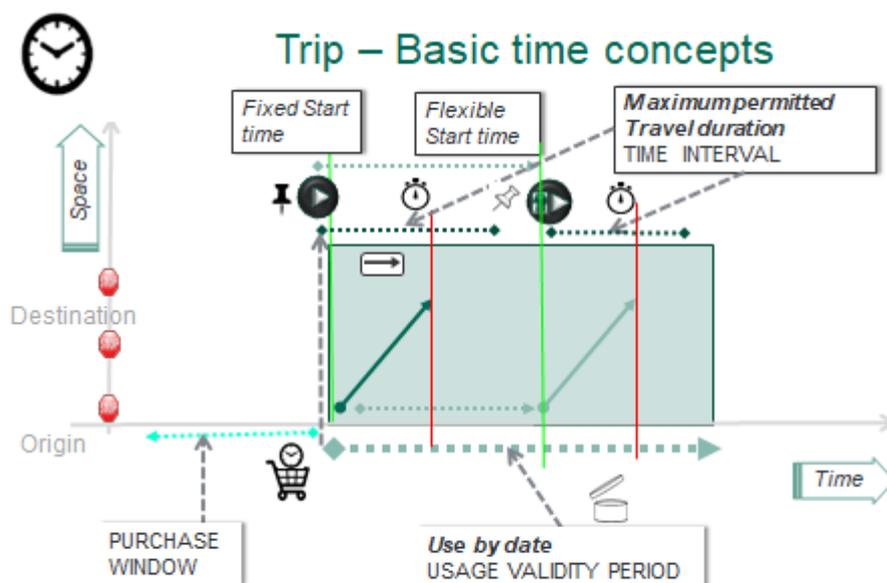


Figure 23 – Basic Time concepts for a single trip

UK Bus Fares Profile

- ❖ In NeTeX, for time limited products such as short hop trips in a zone, one or more TIME INTERVALS (possibly elaborated as TIME STRUCTURE FACTORS) are used to indicate the permitted maximum trip duration – different TIME INTERVAL PRICES may be associated with different durations.
- ❖ A USAGE VALIDITY PERIOD can be used to specify the overall period within which a product must be consumed, and whether it may be given a fixed or variable start point (if the purchase is tied to a specific journey then it will also be fixed).
- ❖ The period within which a ticket must be purchased can be represented by a PURCHASE WINDOW. There may be different windows for different channels, etc.

4.4.2.5.2 Further temporal elements for a single trip

Figure 24 elaborates the case of a single trip to consider in addition trips involving several legs (i.e. with **interchanges** and possible **breaks of journey**) - and also possible temporal restrictions on the commercial conditions:

- The **usage validity period** as introduced above may actually be stated in terms of when the journey is started or completed (or even both).
- **Interchanging window:** if interchanges between services allowed, there may be a maximum period within which interchanges must be made.
- **Exchanging window:** the period with which any exchange of ticket is allowed after purchase (if at all). This may be relative to the original date of purchase, or of planned travel.
- **Refunding window:** the period with which any refund must be claimed. (Which may be relative to the original date of purchase or to the date of travel).
- **Charging moment:** the moment relative to actual travel at which the journey is actually charged to the customer is material for representing tariff structures: most classical travel is prepaid, but modern pay-as-you-go systems (see later below) may instead charge after travel is completed, or take an initial fee, followed by a later adjustment when the total consumption within a period is known.

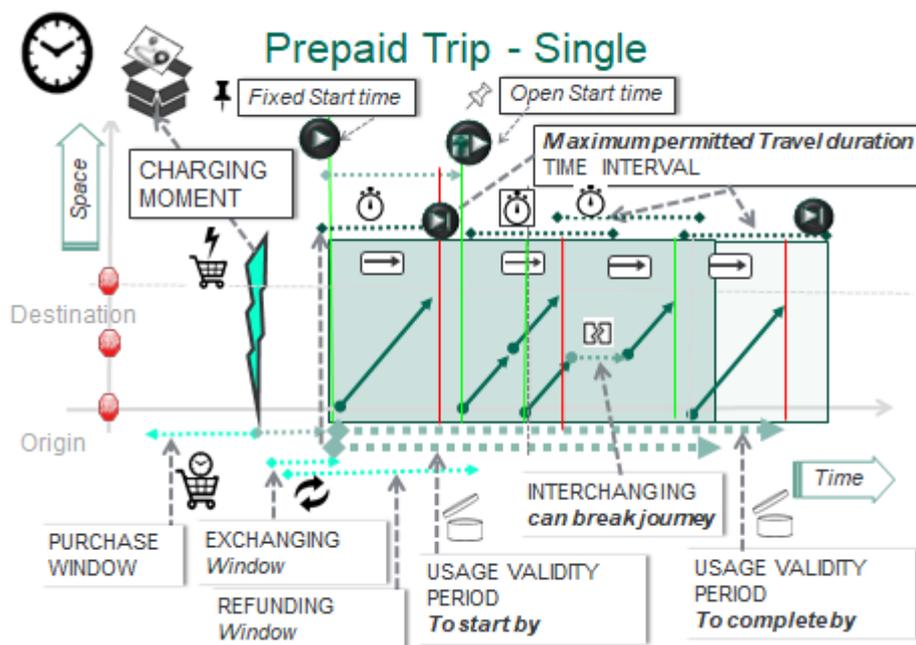


Figure 24 – Further Time concepts for a single trip

UK Bus Fares Profile

- ❖ In NeTeX, an INTERCHANGING usage parameter can be used to set whether interchanges are allowed, the allowed interchange time and whether the journey can be broken.
- ❖ EXCHANGING and REFUNDING usage parameters specify conditions on modifying or refunding a ticket.
- ❖ The point in time at which the user pays for the access rights can be described by a CHARGING MOMENT.

4.4.2.5.3 Temporal elements for a return trip

Figure 25 shows temporal concepts for a return trip, which will in addition have separate validities for the outbound and inbound legs:

- The **usage validity period for the outbound leg** may be stated in terms of when the outbound trip was started or was completed, or when the product was purchased.
- The **minimum stay** can set a minimum period which must be passed at the destination before commencing the return.
- The **usage validity period for the return i.e. inbound leg** may be stated in terms of a period, commencing when the outbound journey is completed, by which time the return journey must be started or completed.

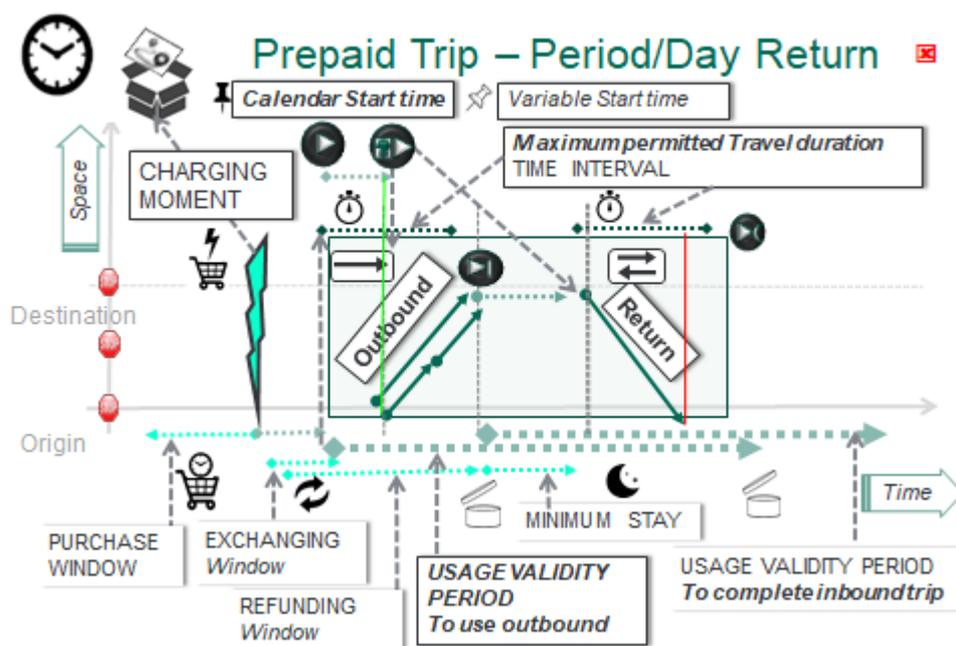


Figure 25 – Time concepts for a return trip

- ❖ In NeTeX, a MINIMUM STAY usage parameter can be used to set requirements for a minimum trip length.

4.4.2.5.4 Charging moments for a prepaid pay as you go trip

Figure 26 introduces the temporal aspects of charging involved in a simple prepaid “pay as you go” trip, made using, for example, a product permitting multiple trips that are charged for only when consumption of each trip starts. Typically, there is a charging moment when an initial purchase of a smartcard or registration in an Account Based Ticketing system is made, and then a further charging moment at the start of each trip when the smartcard or account is debited by a specific amount.

For products where the value is stored on the card, a credit balance must be maintained.

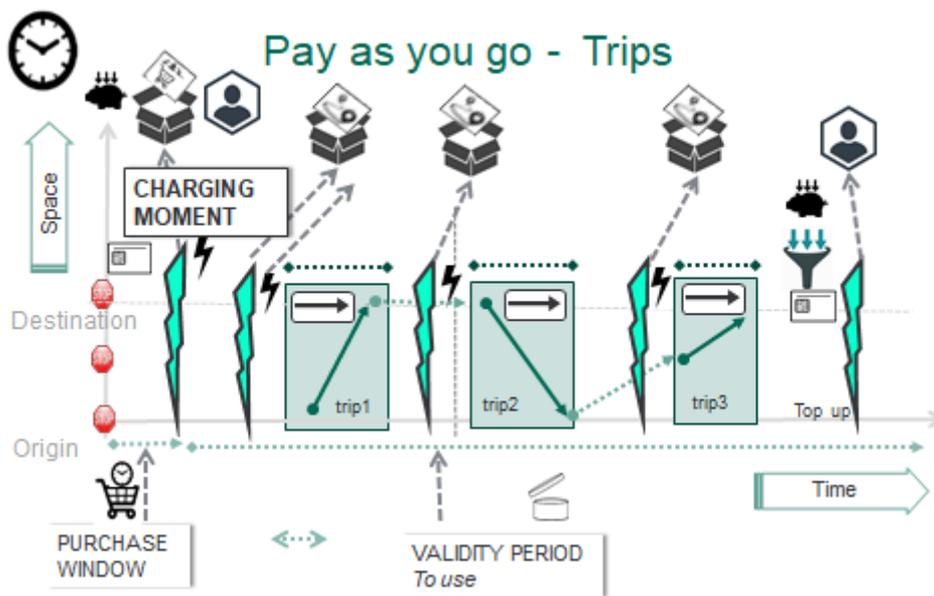


Figure 26 – Charging moments for a prepaid pay as you go trip

4.4.2.5.5 Charging moments for a capped pay as you go trip

Figure 27 shows the more complex temporal aspects of charging involved in a capped pay-as-you-go trip. As for the simple example above, the initial charging moment procures the product; then there is a debit for each trip, however the actual price of the trip is not known until all consumption within a period is complete.

- Capping Rule Time Interval:** within a given time period the product price may be limited so that the total amount paid by the user is capped (for example, no more than a day ticket within a given day, or no more than a weekly ticket within a given week).

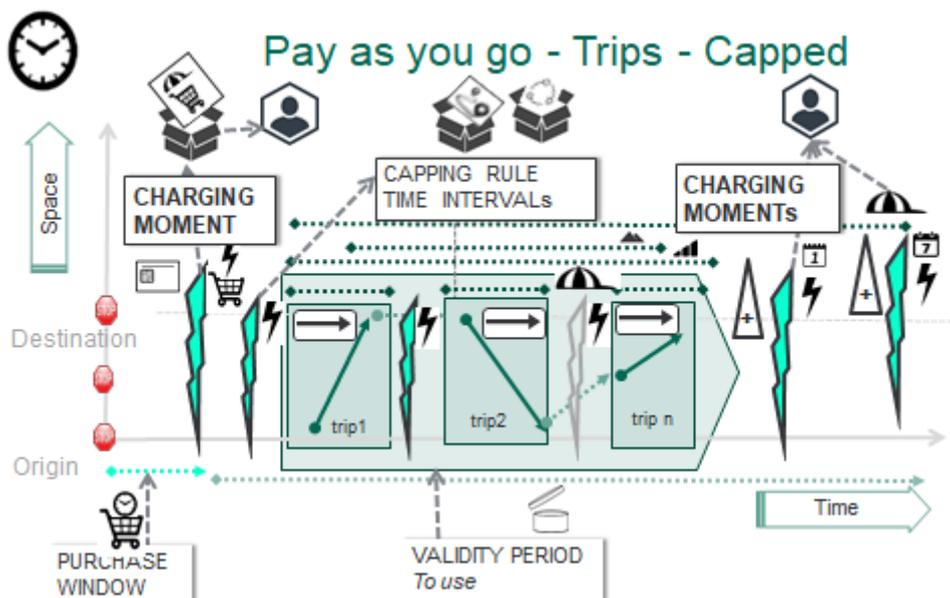


Figure 27 – Charging moments for a capped pay as you go trip

UK Bus Fares Profile

- ❖ In NeTeX, a CAPPED DISCOUNT RIGHT product is used to describe pay as you go products: it can have one or more CAPPING RULES, each with a TIME INTERVAL setting the window within which it applies/

4.4.2.5.6 Charging moments for post-paid trips and for usage-based discounts

Figure 28 shows the use of a capping rule time intervals for a post-paid product, where the charge to the user is noted at the start of each journey but is only made to the user at the end of a set period (possible subject to a capping rule); the time interval indicates when this will occur (end of day, end of week etc). This scenario is typical of the use of EMV credit or debit cards as travel documents; the user does not need to purchase or register for a separate smart card directly and the credit risk is managed as part of their credit card contract.

One or more capping rules can also be used to set usage-based discounts - for example a discount if more than a certain amount of travel is made within a certain period.

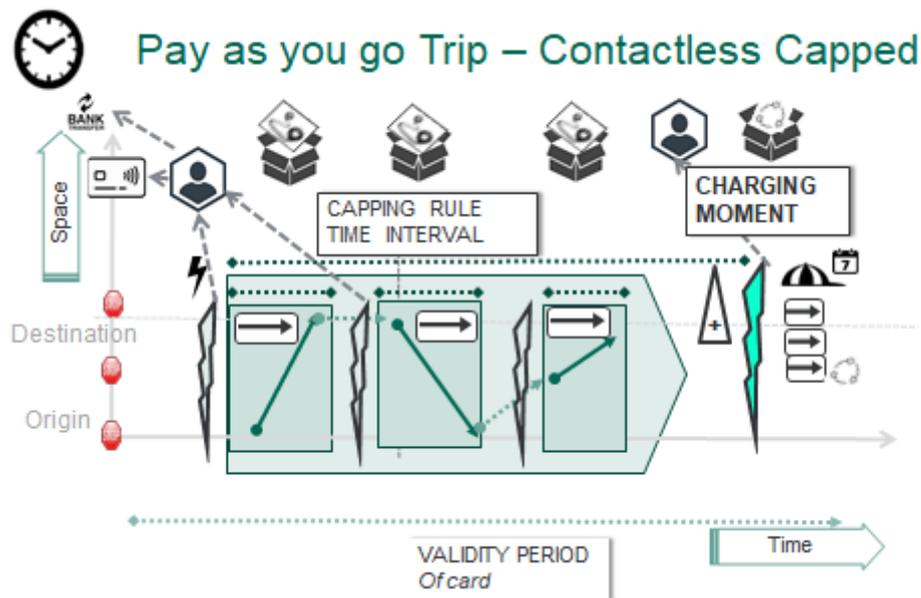


Figure 28 – Charging moments for post-paid trips

- ❖ In NeTeX, a USAGE DISCOUNT RIGHT product is used to consumption-based rebates. a TIME INTERVAL can be used to set the window within which it applies.

4.4.2.6 Illustrating temporal factors for period passes

This section presents visualisations of different temporal concepts found in UK bus period passes (day, week, season, etc.) products in order to distinguish between the different possible usages and to indicate how they can be represented in NeTeX.

4.4.2.6.1 Basic temporal elements for a prepaid pass

Figure 29 introduces the case of a pass that allows repeated travel within a given period (represented by shaded box pointed to the right, within which trips may be made). Temporal concepts include:

- **Pass duration.** For how long the pass is valid (1-day, 1-week, 1-year, etc.).

UK Bus Fares Profile

- **Trips per period:** a frequency of use can indicate whether the pass allows permit unlimited travel or is limited (e.g. to two trips per day, one in each direction, as with some UK bus commuter products).
- A **usage validity period** may further qualify the validity. The start date may be **fixed** according to the calendar (e.g. *Monday*, or “*1st of the month*” or “*1st Jan*”) or **variable** allowing the user to choose any start date in advance, or simply by activation. The pass may run up either to the **end of the calendar day** or to the end of the fare **operating day** (which may be different from the former).
- **Pass holidays.** Some longer season passes allow one or more intervals during which the pass can be suspended for holiday or for sickness (the time being added to the end). Note that this is not currently represented in NeTeX but could be added with a simple extension.
- The **purchase window.** The period before travel within which the product can be purchased. This may be different for **initial purchase** and for **renewal**.
- **Exchanging window:** the period with which any exchange of the pass is allowed.
- **Refunding window:** the period with which any refund or partial refund can be claimed.

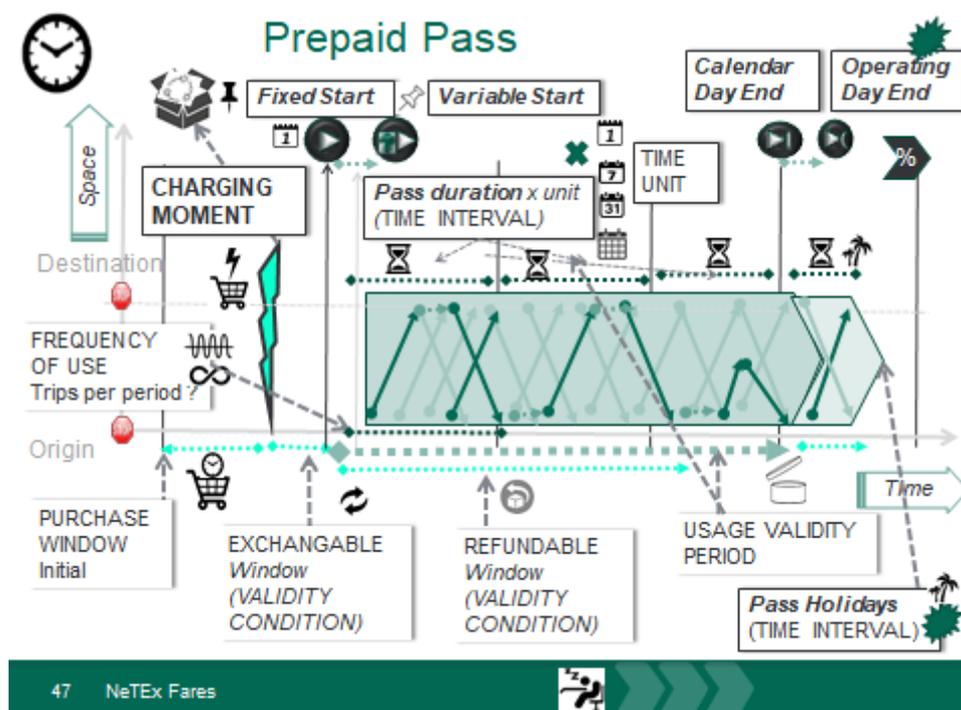


Figure 29 – Temporal concepts for a pass

- ❖ In NeTeX, a FREQUENCY OF USE usage parameter can set the number of trips allowed in a given period.
- ❖ EXCHANGING, REFUNDING and PURCHASE WINDOWS specify time limits as for trip products.

4.4.2.6.2 Payment temporal elements for a pass

Figure 30 extends the case of a season pass to consider subscriptions. Additional concepts include:

- **Subscription validity period:** The period for which a subscription lasts, during which a pass for a given interval (Weekly, monthly etc) will be purchased. The subscription may be **fixed** or **rolling**, i.e. renew automatically or not.
- **Charging moments:** the point at which the pass is purchased or renewed.

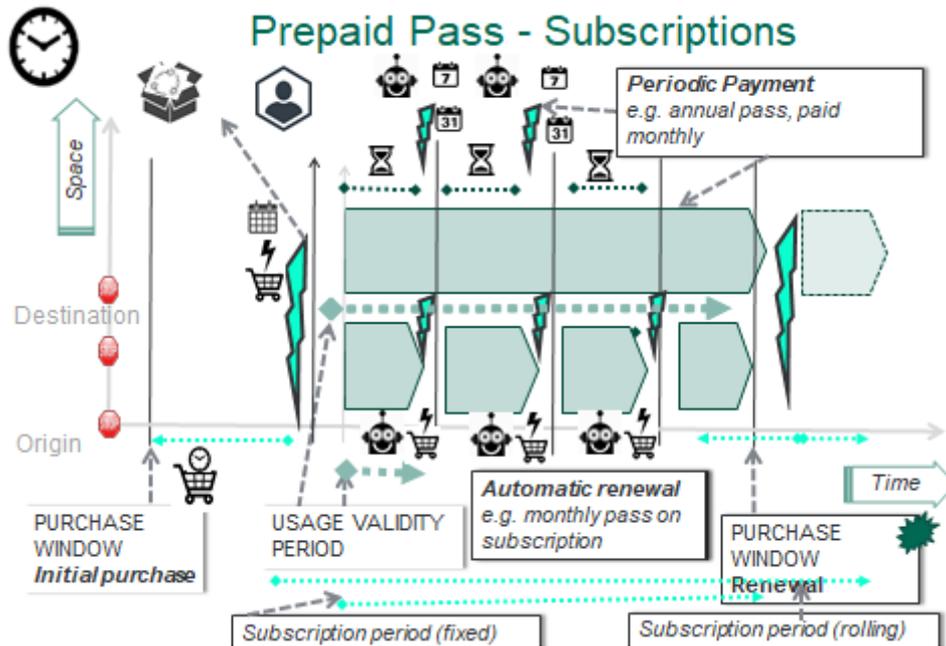


Figure 30 – Subscription Temporal concepts for a pass

4.4.3 Commonly found Fare Products on UK bus

Most UK bus products fall into one of a small number of categories of product type as to the overall access rights for travel they grant; for example, single, return, day pass, season pass, etc.

Table 4 shows the main product types found. The products charge for specific trips, based on different possible underlying tariff structures, described later below. They are further modulated by a large number of parameters and sales conditions, also summarised in the following sections.

4.4.3.1 Common Trip Products

	Nature	Description	Note	FXCP
Trip 	Short hop 	A single trip between an origin and destination limited by the number of stops (Cf Hopper ticket). May or may not allow a journey break (in which case a maximum travel time will apply).	❖ Represented in NeTeX by a PRE-DEFINED ACCESS RIGHT + DESTINATION MATRIX ELEMENT	👉 Basic
	Single 	A single trip between an origin and destination. May or may not allow a journey break (in which case a maximum travel time will apply).	❖ Represented in NeTeX by a PRE-DEFINED ACCESS RIGHT.	👉 Basic
	Time-limited Single ("Hopper")	A single trip whose duration is for a given period (e.g. 30 mins, 1 hour, etc) after activation.	❖ Represented in NeTeX by a PRE-DEFINED ACCESS	👉 Basic

UK Bus Fares Profile

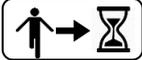
			RIGHT + TIME INTERVAL	
	Day Return 	A return trip between an origin and destination and back. Must be completed in the same fare day (which might extend into the next calendar day if the fare day).	❖ Represented in NeTEx by a PRE-DEFINED ACCESS RIGHT + DESTINATION MATRIX ELEMENT	🔗 Basic
	Period Return 	A return trip between an origin and a destination and back. Must be completed within a certain period.	❖ Represented in NeTEx by a PRE DEFINED ACCESS RIGHT + + DESTINATION MATRIX ELEMENT	🔗 Basic
Multi Trip 	Carnet of Trips 	A bundle of individual trips sold together at a discount, typically to be consumed within a certain time limit.	Book of 10 tickets, etc. ❖ Represented in NeTEx by a NeTEx AMOUNT OF PRICE UNIT	🔗 Basic

Table 4 – Commonly found UK bus Products –Trip

4.4.3.2 Common Pass Products

	Nature	Description	Note	
Pass 	Day Pass, zonal 	The right to make an unlimited number of journeys within a one or zones within a day (Which may run into the next day in certain cases). ❖ Fixed start: For the current fare day ❖ Variable: A 24-hour pass from time of purchase or activation	❖ Represented in NeTEx by a PRE-DEFINED ACCESS RIGHT.	🔗 Basic
	Season, P2P Routed 	The right to make a number of journeys between two points within a certain period. The number may unlimited or of a set frequency e.g. once a day in each direction. May be constrained to	UK Season Ticket ❖ Represented in NeTEx by a PRE-DEFINED ACCESS RIGHT	🔗 Complex

UK Bus Fares Profile

		a route or routes and operator or operators.		
	Season, Zonal 	The right to make an unlimited number of journeys within a given area for certain period (e.g. 1 day, 2 days, 1 week, 1 month, 1 year, etc.).	❖ Represented in NeTex by a PRE-DEFINED ACCESS RIGHT.	☞ Basic
	Season Pass Routed+ Extension 	A hybrid pass allowing commuters to travel a route and also in a central zone at their destination.	London Travel card ❖ PlusBus add on to a Rail ticket	☞ Future
Multi Pass 	Carnet of Day Passes 	A bundle of individual day passes sold together at a discount, typically to be consumed within a certain time limit.	❖ Represented in NeTex by an AMOUNT OF PRICE UNIT.	Basic

Table 5 – Commonly found UK bus Products – Pass

4.4.3.3 Common Discount Products

	Nature	Description	Note	
Discount	Discount Right (TravelCard) 	A product that gives the right to buy other products at a discount.	❖ Represented in NeTex by a SALES DISCOUNT RIGHT	☞ Extended
	Capped Discount 	A product that gives the right to buy other products at a discount, with a further limit on charges within a given period.	TfL Oyster ❖ Represented in NeTex by a CAPPED SALES DISCOUNT RIGHT	☞ Extended
	Usage Discount 	A product that gives the right to a rebate according actual usage. Requires either a smartcard or an account or both.	Oyster cable car rebate. ❖ Represented in NeTex by a	☞ Extended

UK Bus Fares Profile

			USAGE DISCOUNT RIGHT	
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Table 6 – Commonly found UK bus Products – Discount

4.4.3.4 Other Products

	Nature	Description	Note	
Stored Value	Predefined Units 	<p>A bundle of units that may be marked as used to make an arbitrary trip.</p> <p>Relevant for stage fares with a fixed price per stage. If the units are money, corresponds to the balance on a smartcard.</p>	Oyster card stored value	 Basic
Other	Third Party Entitlement	<p>A third-party product or membership schema that gives the holder rights to obtain or purchase a travel product. Can be used for example to represent an identity card issued to authenticate a user as belonging to a specific eligibility group.</p>	❖ Represented in NeTEx by a THIRD PARTY PRODUCT	 Extended

Table 7 – Other UK bus Products

- ❖ The products described all correspond to various types of NeTEx FARE PRODUCT; a number of different specialisations (PRE-DEFINED ACCESS RIGHT, DISCOUNT RIGHT, USAGE RIGHT, FARE SUPPLEMENT, etc). describe specific types of product. In some cases, several different types of NeTEx product may be bundled together in a single sales offer. For example, rail tickets and passes may include a PlusBus element.

UK  Each of the common UK product types is classified with a TYPE OF PRODUCT instance. See Part3

4.4.4 Relating tariffs to the network

A fundamental goal of the fare profile is to ensure that tariffs may be related to the underlying network by journey planners and engines.

Although it is straightforward in NeTEx to specify that specific tariffs or fare products apply to specific timetabled journeys, this is seldom required for bus products (though often found in rail products); rather the tariff is normally stated in terms of what parts of the network (lines, operators, zones, stops etc) and when (time bands etc) it applies to and a trip planner or fare engine must use the trip parameters to select the available fares.

UK Bus Fares Profile

Different methods are used to relate different spatial tariff structures to the network:

- For **point-to-point** tariff between stops, the origin and destination stops can be related directly to the trip stops (for example, by using their NaPTAN stop identifiers).
- For a **flat fare** for a single line, the journey pattern can be used to determine all of the stops of the line.
- For a **zonal** tariff, stops can be assigned to a tariff zone; a trip planner first determines fares that apply between the origin and destination zones. In principle, different methods might be used to make the assignment of stops to zones:
 - **Explicitly:** i.e. membership of a stop of a tariff zone is stated by a link.
 - **Implicitly by projection:** thus, if the coordinates of the stop fall within the bounding polygon of the containing tariff zone, it is deemed to be within the zone. This however cannot be done
 - **By boundary stop:** the stops on the boundary are enumerated and all stops enclosed in the polygon are included.

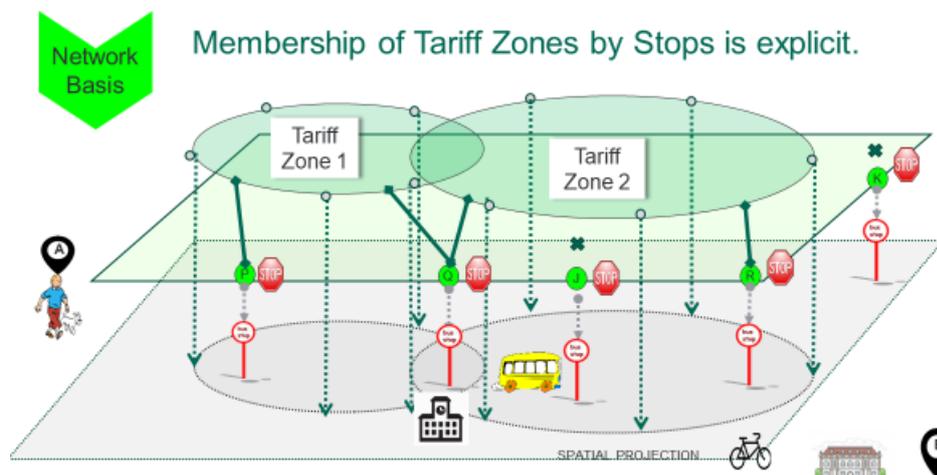


Figure 31 – Relationship of stops to zones

- ❖ The model specifies which stops are in which tariff zone: a stop may be in more than one zone, zones maybe specific to an operator or shared with other operators.
- ❖ Both stops and zones have a spatial projection (i.e. spatial coordinates). However spatial containment of a stop within a tariff zone's extent does not invariably imply semantic membership of the zone. Therefore, although in many cases the stop coordinates can be used to compute which stops are in a given tariff zone so as to populate the membership links of the tariff zone, it is nonetheless important to have an explicit representation.

UK ☞ The UK bus profile assumes membership is explicitly stated; (it is of course possible to use a process to populate a set of explicit memberships from spatial data).

4.4.4.1 Who is responsible for defining tariff zones?

For zone-based tariffs, a key question is who is responsible for defining the tariff zones, that is, for allocating to them identifiers and names and specifying which stops and lines are included? Tariff zones, like stops, need to have unique persistent identifiers.

UK Bus Fares Profile

Responsibility may be specific to an operator or authority, or be managed by a wider consortium

Responsibility type	Description	Example
National	Zones are defined by a national organisation	For example, PlusBus, National Rail areas
Authority	Zones are defined by an Authority and used by many operators.	E.g. TfL London Zones
Group of Operators	Zones are defined by a group of operators. There must be a common process of allocating identifiers E.g. National Rail Network areas	Common organisation e.g. Discovery
Scheme Defined	Zones are defined by an organisation other than an operator	E.g. National Concession Scheme
Other shared zones	Zones are defined by a specific operator and are shared with others.	
Operator specific	Zones are defined by a specific operator and are specific to that operator.	E.g. Metrobus

Table 8 – Specification of Tariff Zones

UK[☞] Where tariff zones are shared, a common codespace and identifier systems must be agreed.

4.4.5 Commonly found Product Durations

Although products in principle could be created with a validity period of any duration, in practice certain durations are much more commonly found in UK bus products (see Table 9). Note however that some season passes allow the number of days or months to be chosen arbitrarily.

	Nature	Description	Comment
Trip 	1-Hour	Ticket valid for up to 1-hour travel.	E.g. Short Trip.
	90-Minutes	Ticket valid for up to 3 hours travel.	E.g. Zonal.
	120-Minutes	Ticket valid for up to 3 hours travel.	
	180-Minutes	Ticket valid for up to 3 hours travel.	
Pass 	24-Hour 	Ticket valid for up to 24 hours travel starting at the time of activation.	e.g. Variable start Day Pass.
	1-Day 	Ticket valid from start of day (or moment of purchase if later) until the end of fare day.	e.g. Fixed start Day Pass.

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	3-Day	Ticket valid for up to 72 hours travel.	
	5-Day	Ticket valid for up to 5 days travel.	May be fixed (Monday) or variable start.
	1 Week 	1 Week pass, fixed or variable start.	May be fixed (e.g. Monday) or variable start day.
	Weekend Only	Pass only valid Saturday and Sunday	
	1 Month 	1-month pass	May be fixed (e.g. 1 st of month) or variable (i.e. any day) start day.
	3-Month	2-month pass.	
	6-Month	3-month pass.	
	12-Month 	1-year pass.	May be fixed (e.g. 1 st of year) or variable (i.e. any day) start day.
	2-Year	2-year pass.	
	3-Year	3-year pass.	Some Rail cards that have Bus discounts.
Student / Youth Pass 	Term (semester)	Valid any day during term-time.	Specific to local academic calendar.
	Term - Schooldays	Valid only on schooldays during term time.	Specific to local academic calendar.
	Academic Year	Valid any day during academic year.	Specific to local academic calendar.
	Holiday	Valid for a holiday period. Summer holiday tickets are most common	Specific to local calendar.

Table 9 – Common Product Duration

- ❖ In NeTeX, a TIME INTERVAL, and / or a TIME STRUCTURE FACTOR is used to represent each different duration (such intervals have several uses). A different TIME INTERVAL PRICE can be associated with each interval.
- ❖ Calendars for School and University terms and holidays may be defined using a SERVICE CALENDAR FRAME.

4.4.6 Commonly found Product Charging moments

An important characteristic of Fare Products is the moment of actual payment for access rights – Table 10.

Nature	Description		
Prepaid	Product is bought outright before travel.	E.g. Classical tickets.	Basic fare profile
Prepaid Subscription	Product is bought by a regular monthly or other period automated subscription at a discounted rate.	E.g. ABO products.	Extended profile
In transit	Product is bought onboard during travel or at exit point; effectively the same as prepaid except that it is permitted to start travel without a ticket.		Extended profile
Pay as you go at start of travel	The user is charged on starting the journey at check in.		Extended profile
Pay as you go Prepayment with adjustment	The user is charged on starting the journey, either for the correct amount, or for an average fare. On completion of the journey, any difference from actual rights consumed is used to make an adjustment. The user may be required to keep a credit balance on the card, either manual or using an auto top up.		Extended profile
Pay as you go post payment	The user is charged on completion of the journey according to the access rights consumed (by explicit or implied check out). Fare calculation may include capping or usage-based rebates.	e.g. TfL Oyster, TfL Oyster Contactless.	Extended profile
Prepaid with rebate.	Account based and smart card systems may offer the user rebates if they exceed certain usage thresholds.		Future

Table 10 – Common Product Charging moments

❖ In NeTEx, a NeTEx CHARGING MOMENT is used to represent the time of payment.

UK  Where tariff zones are shared, a common codespace and identifier systems must be agreed.

4.4.7 Commonly found Fare Demand types

Some bus tariffs are often restricted to certain periods so as to spread demand on congested networks. A different tariff may apply to night operation. Table 11 shows some common distinctions found.

	Nature	Description	
	Peak / Unrestricted	Tariff may be used at any time including at weekends and on public holidays	E.g. Standard walk u tickets.
	Off-peak	Tariff may be used only at off peak times, for example, outside of the morning and / or evening rush hours on working days, and anytime at weekends and on public holidays. Definitions may depend on direction of travel.	E.g. ABO products.
	Weekends and holidays	Tariff may be used only at weekends and on public holidays	
	Night	Tariff applies only at evenings or at night;	

Table 11 – Common Time demand types

- ❖ In NeTEx, a FARE DEMAND TYPE is used to represent a demand period. The actual days and hours of operation can be specified with DAY TYPEs

UK  Time demand periods may be specified in the extended profile.

4.4.7.1 Temporal factors for peak and off-peak demand

This section presents visualisations of temporal concepts concerning time demand periods – in order to spread demand on the network to less congested periods, differential pricing is common for peak and off-peak periods.

4.4.7.1.1 Blackout periods

Figure 32 shows that a travel period may be banded so as to create peak and off-peak periods that meet various conditions

- **Day Type.** Specifying the type of day (week day, holiday, etc.) under which the condition applies.
- **Timeband:** specifying a period within the day.
- **Time at stop.** A further complication is that the time-band may be directional (e.g. into or out of a specific station) and that the specific time may vary station by station, so for example the time band starts at 08:50 at station A, 08:53 at Station B, 08.58 at station C, etc.

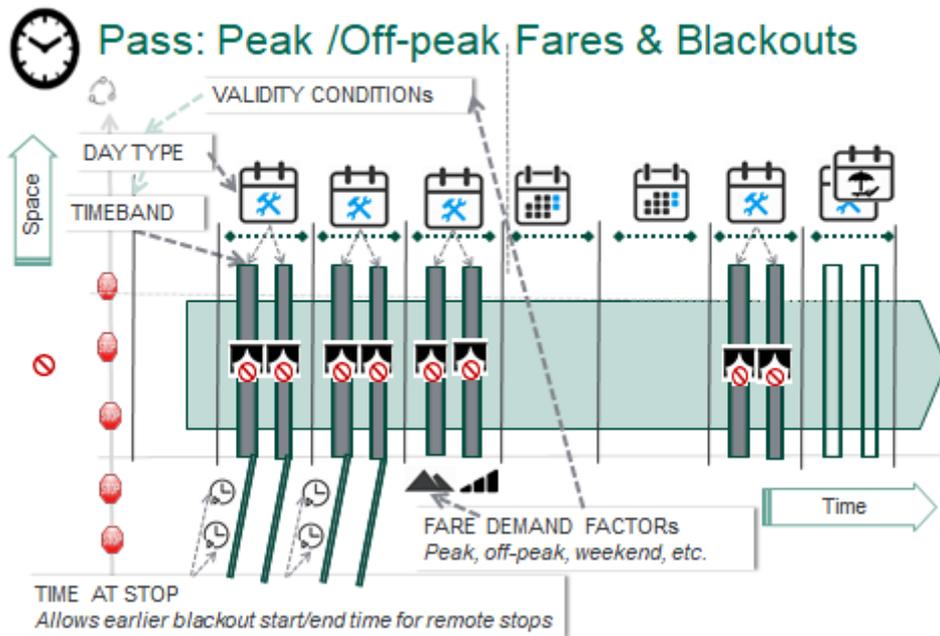


Figure 32 – Blackout day types and timebands

- ❖ In NeTEx, different demand periods can be represented as FARE DEMAND FACTORS. These be defined in terms of DAY TYPEs, TIME BANDs and other validity conditions. A TIME AT STOP element can be used to define the time relative to a specific stop.
- ❖ A SERVICE CALENDAR can be used to specify which DAY TYPEs apply on a given calendar day.

4.4.7.1.2 Time demand restrictions on an individual Trip

Figure 33 shows time demand restrictions as applied to an individual trip. The restrictions may apply to any or all of the start of the trip, the end of the trip or the course of the trip

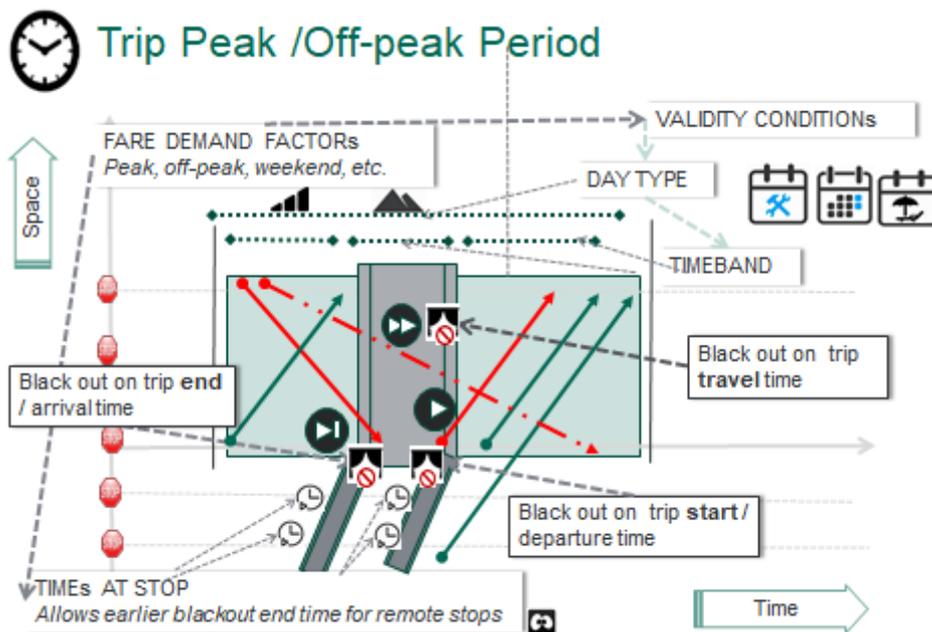


Figure 33 – Time demand restrictions on an individual Trip

4.4.8 Single and multiple operator access

A tariff may be specific to an operator, such that it can only be used on that operator’s services, or be honoured by multiple operators (for example the UK comm zonal addon for rail, *PlusBus*). Or it may be that different operators offer different tariffs covering overlapping areas, or specifically cover journeys that go from one operator’s services to another’s.

- ❖ In NeTEx access rights and tariffs may be specific to an OPERATOR or to a GROUP OF OPERATORS,
- ❖ The OPERATOR and GROUP usually, but not always, sell their own tickets. Other distributors may also be used, such as TRAVEL AGENTS, or o a RETAIL CONSORTIUM (a sales organisation representing a group of operators).

4.4.9 Commonly found Passenger Types in UK bus

Tariffs usually segment the market, with different prices for different types of users. Certain products or certain discounts to products may be restricted to specific types of user who must meet specified eligibility criteria.

- Some of these categories may be immediately available to anyone (e.g. *Adult, child*), others may require documentary proof (e.g. a disabled card) and/or prior registration (e.g. to get a senior discount in the TfL you must have a Senior Oyster card).
- Some profiles entitle the user to take companions (children, assistants, dogs, etc.) either free or at a discount (so can be considered as “group tickets”).
- Certain user profiles may be ordained by statutory measures, with eligible users being allowed a concessionary discount.

User profiles may also apply to the purchase of group tickets – see next section.

Commonly found user profiles in many countries are shown in Table 12. Although broadly the same categories are found in most countries, for the age dependent user types, there are distinct variations as to the ages for eligibility in specific groups.

	Nature	Description
	Adult	Any person too old for a child or youth discount. Some products may have a minimum age. E.g. in order to gain the right to take an infant free or a child at a discount.
	Infant	Babes in arms and children. Maximum age varies between countries – from 4 to 6 years old. Usually travel free without a seat. Cannot travel unaccompanied.
	Child (Accompanied)	Children who are no longer infants, accompanied by a parent or sibling. Usually discounted by between 30-50%, or free. Both the minimum and maximum ages for being eligible for child fares vary considerably between countries an even within countries. Minimum is typically between 5 and 7 years old, maximum varies from 12 to 16 years old. In a few cases there is even variation within a

UK Bus Fares Profile

		<p>country for specific products (for example, some airport shuttle services).</p> <p>Some countries / products require the child to be a descendant (i.e. son/daughter or grandchild of the adult).</p>
	Child (Unaccompanied)	<p>A child (see above) travelling without an adult. Usually eligible for a discounted fare, but not free as for some fares for accompanied children.</p> <p>There is usually a minimum age for being allowed to travel unaccompanied.</p>
	Youth	<p>Young person over the minimum age for child discounts (see above - typically 15 years) and below the age for adult (e.g. between 18 and 26 years).</p>
	Pupil	<p>School children in full time education. Usually under 19.</p>
	Student / Trainee	<p>Person attending an accredited college. Usually under a certain age (e.g. 26), with special provision for PhDs and mature students.</p>
	Senior	<p>Persons over a certain age (or formally registered as a pensioner), often statutory. Usually eligible for a discount. Age varies between countries (typically between 60 and 65 years old, but in some cases as high as 70). Some rights may be restricted to local residents or nationals. A few countries have different age bands for seniors (e.g. 0-65, 65-70, 70+) with different rights.</p>
	Disabled	<p>Usually Statutory. May be subdivided into different categories, e.g., Blind, severely handicapped, handicapped child, invalid, etc.</p>
	Disabled Companion	<p>Companions to disabled, veterans or other specific types of user. Usually discounted or free.</p>
	Social Benefits	<p>Unemployed, qualifying for special social benefits, etc. Usually registered membership scheme.</p>
	Armed forces	<p>HM armed forces</p>
	Special Occupation	<p>Member of an organisation participating in an employee ticket scheme. Discounted, sometimes with tax benefits.</p>

UK Bus Fares Profile

	Member	Member of a membership scheme offering discounts to its members.
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Table 12 – Commonly found categories of passenger

- ❖ In NeTeX, USER PROFILE elements are used to represent different types of individual user and their eligibility conditions such as age, registration, etc. COMMERCIAL PROFILE elements are used to represent different types of corporate and organisational user.
- ❖ In specify age conditions, precision is needed to say when the age is actually measured (e.g. actual birthday, age on 1st January, etc), especially in the cases of season passes valid for an extended period during which a user’s eligibility may change. NeTeX allows various specific conditions to be expressed.
- ❖ Often a profile is distinguished so that a different price can be offered to eligible users (as indicated by a DISCOUNTING RULE).

UK[☞] A set of standard UK USAGE PROFILES is proposed in Part3. Note however that certain detailed condition (e.g. the age limits for “a child”) vary between operators, so operator specific profiles will also be needed.

4.4.10 Commonly found Group Tickets in UK bus

Tariffs often offer a discount to groups of users travelling on a single ticket. There may be complex rules as to how these groups are made up of specific types of user, with minimum and maximum numbers of users of a specific type (e.g. Two to five adults with up to three children). Groups commonly found in UK bus tariffs are shown in Table 13.

	Nature	Description
	Family	Family with at least one child under a qualifying age (e.g. 15). In some cases, children must be related to the adult (child or grandchild).
	Group	Groups travelling together on a single product, usually at least three.
	Large Group	Large groups travelling together on a single product. Usually require longer lead times to book, and conditions for modifying the number of users closer to time of travel may be material.
	Student Group	Groups of school pupils or students, accompanied by supervisors. A certain ratio of adults to students is required. Places for supervisors may be free or discounted.
	Duo / Two Together	Two adults at a discount, usually off peak.

Table 13 – Commonly found Group tickets passenger

- ❖ In NeTEx, the GROUP TICKET element describes allowed combinations of user types (i.e. USER PROFILES) and their associated discounts.

4.4.11 Commonly found Conditions of Use in UK bus

Products may be subject to specific conditions about the consumption of access rights. Commonly found distinctions include.

	Condition	Name	Note
	Can break Journey	Whether the user can break the journey along the route, as long as the overall travel time limit is met.	E.g. A UK rail single allows a break of journey.
	Can interchange	Whether the user can make an interchange to another service or can only use one vehicle. This constraint is meaningful for zonal or stage counting journeys.	❖ In NeTEx, specified by the INTERCHANGING usage parameter.
	Any route permitted	Whether the user is limited to a specific route.	❖ In NeTEx, specified by the Exact Routes can be specified using the SERIES CONSTRAINT mechanism.
	Frequency	How many times the fare product may be used in a given period. For example, a season pass may give unlimited use, or be limited to two journeys a day.	❖ In NeTEx, specified by the FREQUENCY usage parameter.
	Is transferable	Whether another person can use the product or whether it is personal to a user.	❖ In NeTEx, specified by the TRANSFERABILITY usage parameter.
	Maximum distance	Maximum distance allowed for a product.	
	Maximum journey time	See temporal conditions.	

Table 14 – Commonly found conditions of use

- ❖ In NeTEx, a number of different types of USAGE PARAMETER are used to set additional conditions as to how a product may be used. These can include ROUTING, INTERCHANGING, TRANSFERABILITY, etc., etc.
- ❖ Maximum distance can be specified by a DISCOUNTING RULE.

4.4.12 Possible Supplement Products on UK bus

Long distance modes such as coach / rail may include additional supplement products which a ticket holder can purchase to complement their basic access rights. For example, an upgrade to first class, or a ticket for an accompanying bicycle.

Table 15 shows some possible product supplement types. The products build on underlying tariff structures described later below.

	Nature	Description	Note/ Example
Return Trip 	Excursion	Includes entry price to an attraction or event	
Trip  	Seat Reservation 	Seat reservation may be included in price or may be charged extra.	Only relevant for coach
	Animal Ticket 	Extra ticket for a dog or other animal on the trip.	Guide dogs are usually free. Usually free a flat fee.
	Excess Luggage 	Extra for luggage that exceeds free allowance, e.g. outsize sports equipment, extra suitcases, buggy, etc.	Usually a flat fee.
	Parking	Parking at origin stop for duration of return trip at discounted or free price.	

Table 15 – Commonly found Supplement Products

- ❖ A supplement product is normally represented in NeTeX by a FARE SUPPLEMENT (If it involves complex access rights a PREASSIGNED FARE PRODUCT may also be used). ENTITLEMENT GIVEN and ENTITLEMENT REQUIRED usage parameters can be used to indicate the dependencies between fare products.

UK  Most supplements apply to long distance travel.

4.5 Overview of other UK Bus product features

In addition to the tariff aspects discussed above (temporal and spatial, user type etc) UK bus tariffs may be based on a number of other factors such as the ticket media, distribution channel, etc., etc.), as described below.

UK Bus Fares Profile

Each of these aspects correspond to specific components in the NeTEx Model, some relevant components are noted in each section so as to give an indication as to how the fare might be encoded as a NeTEx document.

4.5.1 Commonly found Types of Travel Document in UK bus

In order to travel, passengers require some form of travel document to prove they have purchased the required access rights. Travel document may take the form of either paper, plastic or electronic media. For either commercial or technical reasons, certain products may be available only on certain media. Electronic and Account Based Ticketing fares are also becoming increasingly common, in some systems a payment card or device may be used as a travel document.

Since there are different levels of operational cost and convenience associated with different media types, sales offer packages may be priced differently according to the media they use.

	Type of Travel Document	Name	Note
	Paper Ticket	Printed or handwritten paper ticket.	Not machine readable.
	Machine readable printed ticket	Machine printed ticket.	Readable by OCR, barcode, shot code or magnetic stripe
	Self-print ticket	Self-print ticket (on paper or held electronically).	Machine readable by OCR/barcode.
	Smartcard	Card containing chip able to store apps and /or documents. May be used in conjunction with an online account.	Usually machine readable either by OCR, Barcode or NFC.
	Device App	On device application holding ticket.	Machine readable by OCR, barcode, or NFC.
	EMV	Credit or Debit card used as an identity token.	Machine readable by magstripe, or NFC.
	SMS	Token held as SMS on device.	Not machine readable.
	Identity Card	Membership card accepted as document.	
	Other	Pass or other proof of rights.	Not machine readable.

Table 16 – Commonly found Types of Travel Document

- ❖ The available ticket formats can be indicated in NeTEx by a TYPE OF TRAVEL DOCUMENT.
 - The UK Bus Profile defines a standard set of instances that should be used
- ❖ The available TYPEs OF TRAVEL DOCUMENT that apply to a product are specified on a SALES OFFER PACKAGE

4.5.2 Commonly found Fulfilment Methods for UK Bus

Fulfilment describes how a travel document certifying the purchase of access rights is delivered to the customer. The methods used will typically vary according to the nature of the channel and the types of travel documents available (Electronic, printed etc). or any given channel there will be one or more possible methods

- There may be surcharges for certain methods, such as post.

	Fulfilment	Description	Note
	Collect at Counter	Travel document is collected at ticket counter.	Widest selection.
	Collect from Ticket Machine	Travel document is collected from an automatic self-service machine.	Standard products.
	Collect at barrier / validator	Product is collected by using a validator or barrier	
	Issued on Board	Product is issued on board from conductor or machine on board.	Often at a premium
	Download and print	Downloaded and printed onto paper.	
	Download as e-document	Downloaded and held on a mobile device for inspection.	
	Postal mail	Travel document is sent by post.	
	Courier	Travel document is sent by courier.	Usually additional fee.
	Mobile App	Travel document is downloaded to a mobile device and held in electronic form.	The app may apply additional intelligence as to how the document is used,

UK Bus Fares Profile

			e.g. activation or validating it.
	SMS	Travel document is sent as an SMS message.	

Table 17 – Commonly found Fulfilment Methods

- ❖ The available methods be indicated in NeTeX by a FULFILMENT METHOD. Particular payment methods and fulfilment methods can be associated with a specific DISTRIBUTION CHANNEL by means of a DISTRIBUTION ASSIGNMENT.
 - The UK Bus Profile defines a standard set of instances that should be used

4.5.3 Commonly found Payment Methods for UK bus

The permitted methods of payment may vary from channel to channel and product to product. Most channels will limit payment to one or more methods.

There may be a discount for payment with a specific method.

	Method	Description	Note
	Cash	Currency – notes and or coins	On Board May be limited to exact fare
	Debit/Credit card	Payment from account by standard EMV card.	Some operators participate in credit card schemes.
	Contactless card	Payment from account standard EMV card with NFC to a terminal.	
	Mobile Payment	Mobile device Payment system such as Apple pay, Google pay, etc.	May be linked to a Mobile app.
	SMS	Payment by SMS from mobile operator account of user.	Low value fares only
	Cheque	Cheques are still supported in some countries	May be subject to limit.
	Direct transfer	By direct transfer from a bank account.	Used for Season tickets.

UK Bus Fares Profile

	Standing order	Products on subscription may be paid for by direct debit at a specified interval (monthly, quarterly, etc)	Used for subscriptions for season tickets.
	Coupon	Payment or part payment may be by redeeming a coupon.	Usually additional fee.
	Mileage Points	Payment or part payment may be by redeeming accumulated mileage points form a frequent traveller scheme.	Requires an account.
	Warrant	Payment may be by submitting a travel warrant (e.g. for armed forces).	
	Gift voucher	Payment or part payment may be by redeeming a gift voucher for a specified amount.	

Table 18 – Commonly found Payment Methods

- ❖ The available payment methods can be specified in NeTex by a PAYMENT METHOD. Particular payment methods and fulfilment methods can be associated with a specific DISTRIBUTION CHANNEL by means of a DISTRIBUTION ASSIGNMENT.
- ❖ The UK Profile will define a number of different instances of PAYMENT method that should be used by preference.

4.5.4 Commonly found Distribution Channels for UK bus

Different products are typically made available for purchase by the public through different sales channels. There may be specific conditions as to which distribution channel can be used to obtain a product. The separate concepts of fulfilment method and payment method are discussed in subsequent sections.

- There will sometimes be a discount for products bought through self-service and advance purchase channels.
- There may be different after-sales conditions attached to different channels. For example, the right to refund or exchange a ticket may only apply if the ticket was bought over the counter.

Channel	Description	Note
	In station counter.	Widest selection of products. May exclude online-only offers.

UK Bus Fares Profile

<p>At stop Machine</p> 	<p>Automatic self-service machine at stop.</p>	<p>Standard products.</p>
<p>On Board</p> 	<p>On board from conductor or machine.</p>	<p>Often more expensive and restricted as to products and discounts offered.</p>
<p>Online Web</p> 	<p>One line from a web interface. Subsequent</p>	<p>Fulfilment may be self -print or electronic, or by mail.</p>
<p>Mobile App</p> 	<p>Self-service mobile app using mobile data or wifi.</p>	<p>Fulfilment will normally be handled via the app</p>
<p>SMS</p> 	<p>Self-service using GSM phone with SMS.</p>	
<p>Account Based Ticketing with PAYG</p> 	<p>Pay as you go. May be smartcard or online account based (e.g. for contactless EMV card), or both.</p>	
<p>Central Office</p> 	<p>Certain products may only be available at central ticket offices in person.</p>	<p>Common for Annual passes and special discounts</p>
<p>Call centre</p> 	<p>Certain products may only be available by phone or by emailing a service centre.</p>	<p>May be different prices for different speeds of fulfilment: first class post, courier, etc. Email may also be used for fulfilment</p>
<p>Third Party Retailers</p> 	<p>Including kiosks, newsagents etc with retail footfall.</p>	<p>May charge an additional fee.</p>

Table 19 – Commonly found Distribution Channels

- ❖ The available channels can be represented in NeTEx by DISTRIBUTION CHANNELS. Particular payment methods and fulfilment methods can be associated with a specific DISTRIBUTION CHANNEL by means of a DISTRIBUTION ASSIGNMENT that applies to a specific SALES OFFER PACKAGE.

4.5.5 Commonly found After Sales conditions in UK bus

Fare Products and/or sales packages may be subject to specific conditions about the after sales commercial rights of the user.

Trip	Single	
Can modify time of travel/ Exchange 	Whether the time of travel or route can be modified.	❖ EXCHANGING usage parameter.
Can Refund 	Whether the user can obtain a refund for and unused or partly used product, either ahead of travel or after having failed to use it. Mainly relevant for season passes.	❖ REFUNDING usage parameter.
Replacement possible 	Whether a replacement can be obtained if lost, possibly retaining the balance on an account-based product. Mainly relevant for season passes and smartcard products	❖ REPLACING usage parameter.

Table 20 – Commonly found After Sales Conditions

- ❖ In NeTEx, a number of different types of USAGE PARAMETER are used to set additional commercial conditions on post-sales handling of the ticket. These can include EXCHANGING, REFUNDING, REPLACING, etc., etc.

4.6 Summary of UK Bus Price features

An important aspect of fares is of course the **fare price**, that is, the monetary amount associated with each selectable combination of tariff feature.

- ❖ In NeTEx, prices are represented separately from the elements that are priced, making it possible to have successive prices sets at different times with different validity periods, without altering the tariff structure. It also allows for prices for the same products to be stated in different currencies, or even, for example, be stated in other valuation units such as frequent flier points from a membership scheme.
- ❖ Prices are represented as specialisations of FARE PRICE.
- ❖ Sets of prices can be organised using a FARE TABLE – see later below. Prices may be included in the same document as the fare structure, or be exchanged separately.
- ❖ It is also possible to indicate that some or all prices are supplied dynamically through a pricing service, as for many yield managed products.

4.6.1 Pricing dimensions

A fundamental consideration for the scope of the profile is the range of different factors used to price a fare. Anything which is a pricing factor for a UK Bus Fare needs to be represented by a priceable model element in the profile. Thus, for example DISTANCE MATRIX ELEMENTS, TARIFF ZONES, TIME INTERVALS, USER PROFILES, TYPES OF TRAVEL DOCUMENT all variously contribute to prices and so are included in the profile.

Other factors may be relevant for passenger information, but do not necessarily need to be modelled for a basic profile. For example, if different prices are offered for children and seniors, then a user type (USER PROFILES - e.g. *adult, child, senior*) needs to be in the profile and to have an associated price. The actual rules for when a customer is eligible to be a child or senior (e.g. ages, accompanying companion, residency) do not necessarily have to be populated.

The price table for a given SALE OFFER PACKAGE is typically an NxN matrix of all the relevant factors, (possibly with certain combination instances excluded.). The actual choice of factors depends on the tariff structure and product type. See part3 for a discussion of the relative dimensions of different Tariff structures.

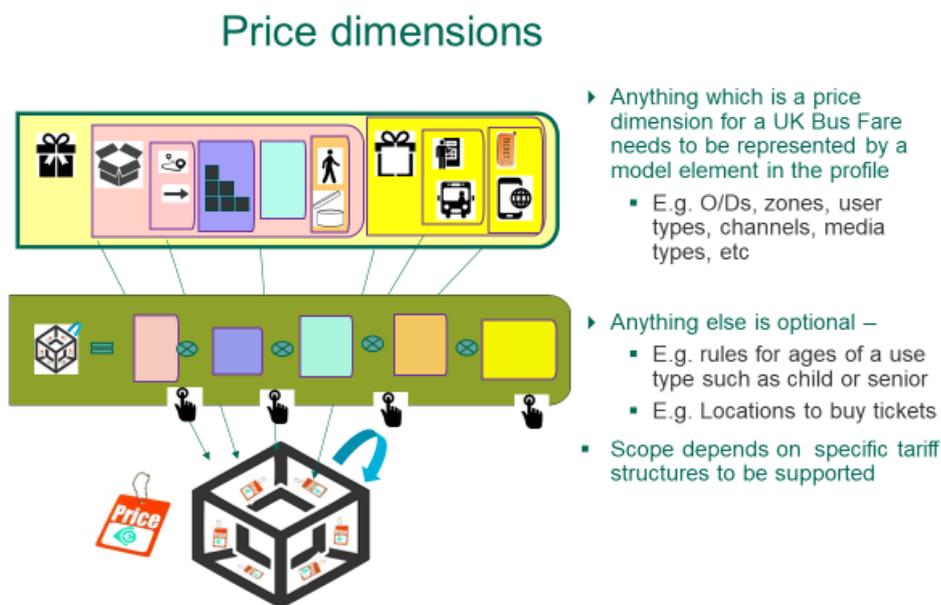


Figure 34 – Pricing dimensions.

The most common combinations found in price tables are the following:

Point-to-point trip

- DISTANCE MATRIX ELEMENT x USER PROFILE x (SALES OFFER PACKAGE)

Stage fare trip

- GEOGRAPHICAL INTERVAL x USER PROFILE x (SALES OFFER PACKAGE)

UK Bus Fares Profile

Zonal Fare

- FARE ZONE x TIME INTERVAL x USER PROFILE x (SALES OFFER PACKAGE)

Where the SALES OFFER PACKAGE also embodies a specific media (TYPE OF TRAVEL DOCUMENT) – such as *paper, smartcard, or mobile app* – and DISTRIBUTION CHANNEL (e.g. *at stop, on-board, online*).

4.6.1.1 Other pricing dimensions

Other factors may also apply, for example the FULFILMENT METHOD, if an additional charge is charged for delivery by post or courier.

The following figure summarises the NeTex elements most relevant as price dimensions.

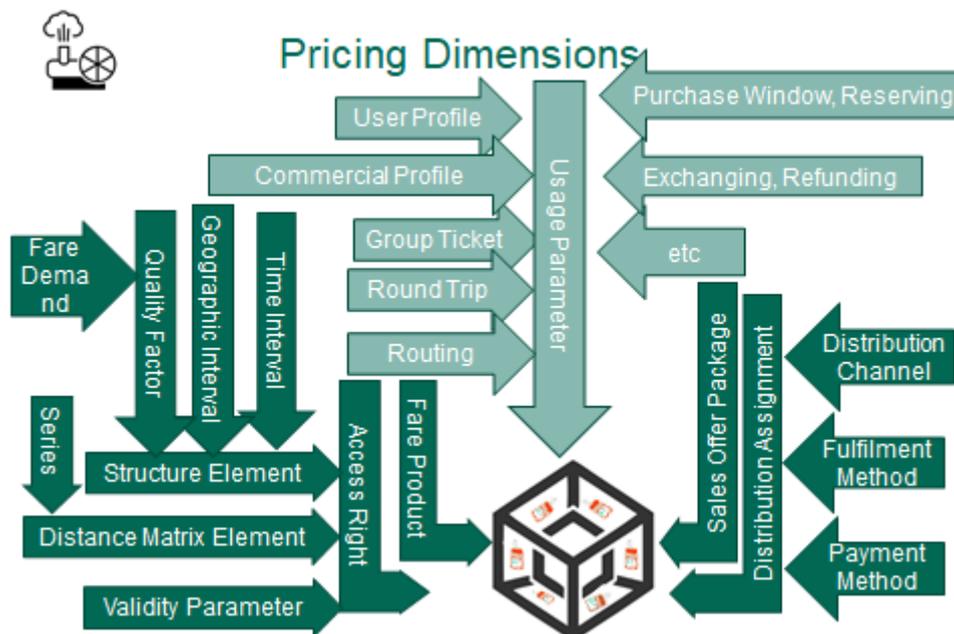


Figure 35 – NeTex Pricing dimension elements

4.6.2 Absolute and derived prices

Passenger information for UK bus fares includes both prices stated as absolute amounts (e.g. £4.50) and prices stated as a derivation of another price (E.g. *The child price is 50% of the adult price*), or *each additional person on a group ticket is £1.00*).

- ❖ NeTex supports complex price derivation rules, with discounting factors and minimum and maximum limits, so that one price may be derived from another (using a PRICE RULE, DISCOUNTING RULE or LIMITING RULE).
- ❖ ROUNDING rules may be specified for the calculation so that the result is quantized to specified currency units.
- ❖ The derivation of a price may be recorded as a RULE STEP.
- ❖ Prices may be attached to many different types of tariff structure and fare product element. The allowed combinations of prices of the different types of factor can be used to create an n-dimensional pricing matrix.

4.6.3 Organisation of UK bus prices

The exchange of fare data typically involves the exchange of large numbers of prices. Typically, there will be a separate price for each permitted combination of the discrete tariff and product elements.

- ❖ NeTEx provides a structure, the FARE TABLE to allow the efficient organisation of prices as nested tables. A fare table is made up of CELLS.

Prices can be arranged as hierarchically nested rows, with tariff elements attached to each nesting level, as shown in Figure 37.

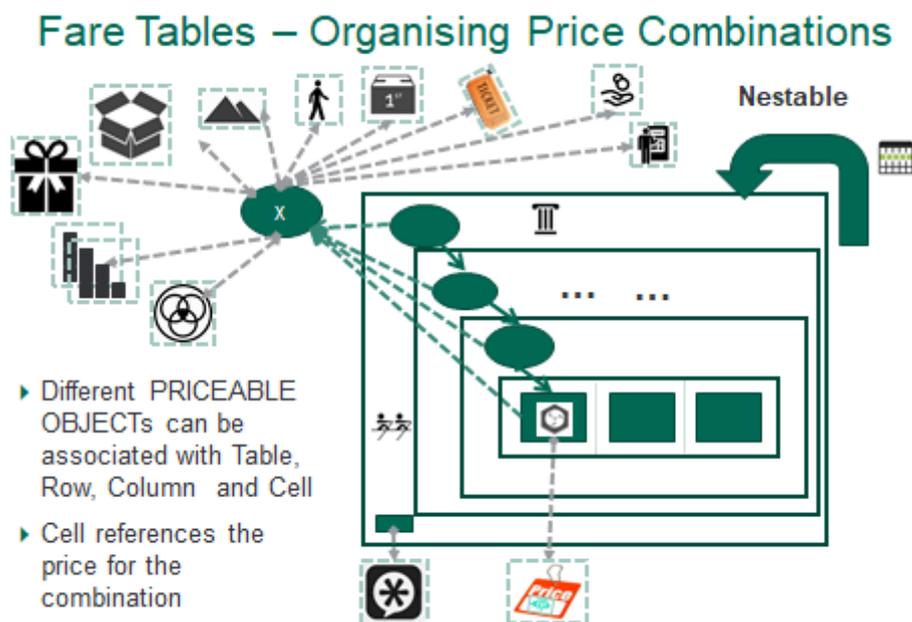


Figure 37 – Nesting prices for fare elements

The optimum hierarchy can be chosen for any given application

The following table (Table 18) gives some examples of price data for some products and their permitted combinations of parameters that might be nested in various alternate hierarchies, for example, as ordered in the table, it could be nested:

- *A to B / Product / Class of Use / User Type / Channel / Media*

However, it would so be possible to nest the data according to any one of several arbitrary alternative hierarchies, for example:

- *A to B / Product / User Type / Class of Use / Channel / Media*
- *A to B / Product / Channel / Media / User Type / Class of Use*
- *Class of Use / User Type / Product / Channel / Media / A to B*
- *etc*

O/D	Product	Type	Class of Use	User Type	Channel	Media	Amount
A+B	Single	Trip	1 st Class	Adult	online	selfprint	10.00
A+B	Single	Trip	1 st Class	Adult	online	mobile app	9.00

UK Bus Fares Profile

A+B	Single	Trip	1 st Class	Adult	at stop	smart card	9.00
A+B	Single	Trip	1 st Class	Adult	at stop	printed	11.00
A+B	Single	Trip	1 st Class	Adult	onboard	printed	12.00
A+B	Single	Trip	2nd Class	Adult	online	selfprint	7.00
A+B	Single	Trip	2nd Class	Adult	online	mobile app	6.00
A+B	Single	Trip	2nd Class	Adult	at stop	smart card	6.00
A+B	Single	Trip	2nd Class	Adult	at stop	printed	8.00
A+B	Single	Trip	2nd Class	Adult	onboard	printed	8.50
A+B/B+A	Return	Trip	1 st Class	Adult	online	selfprint	18.00
A+B/B+A	Return	Trip	1 st Class	Adult	online	mobile app	16.00
A+B/B+A	Return	Trip	1 st Class	Adult	at stop	smart card	17.00
A+B/B+A	Return	Trip	1 st Class	Adult	at stop	printed	19.00
A+B/B+A	Return	Trip	1 st Class	Adult	onboard	printed	n/a
A+B/B+A	Return	Trip	2nd Class	Adult	online	selfprint	12.00
A+B/B+A	Return	Trip	2nd Class	Adult	online	mobile app	10.00
A+B/B+A	Return	Trip	2nd Class	Adult	at stop	smart card	10.00
A+B/B+A	Return	Trip	2nd Class	Adult	at stop	printed	11.00
A+B/B+A	Return	Trip	2nd Class	Adult	onboard	printed	n/a
A+B	Pass	1 week	1 st Class	Adult	At counter	smart card	100.00
A+B	Pass	1 month	1 st Class	Adult	At counter	smart card	350.00
A+B	Pass	1 week	1 st Class	Child	At counter	smart card	50.00
A+B	Pass	1 month	1 st Class	Child	At counter	smart card	175.00
A+B	Pass	1 week	2nd Class	Adult	At counter	smart card	60.00
A+B	Pass	1 month	2nd Class	Adult	At counter	smart card	200.00
A+B	Pass	1 week	2nd Class	Child	At counter	smart card	40.00
A+B	Pass	1 month	2nd Class	Child	At counter	smart card	120.00

Table 21 – Sample Product Price data for trip from A to B

4.6.4 Presentation of fares and fares prices

NeTEx is concerned primarily with the semantic aspects of representing fare, rather than with presentation aspects such as layout, formatting and fonts of tariff tables. It does however have some basic layout capabilities that are useful to guide rendering of data in a tabular form, as indicated in Figure 38.

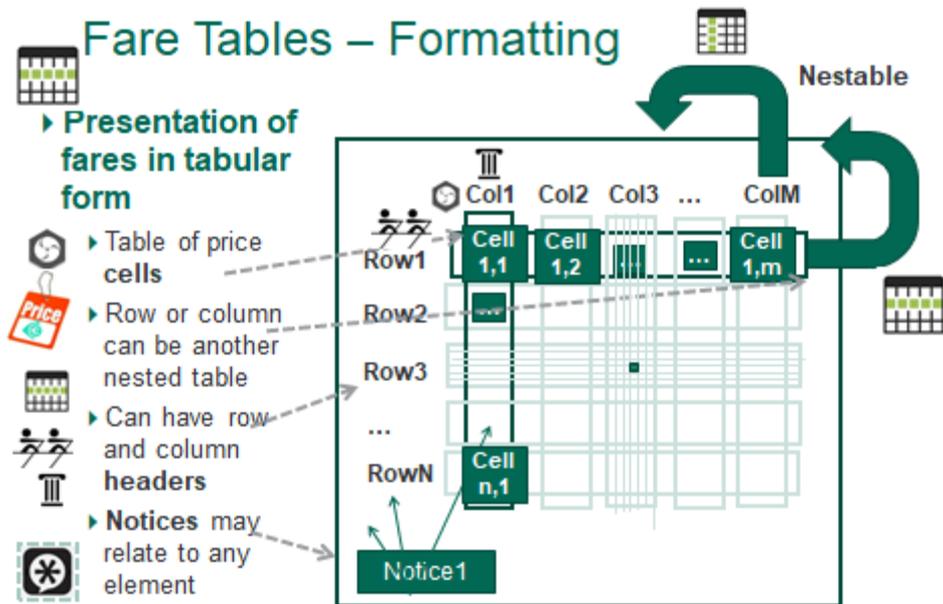


Figure 38 – Formatting a fare table

- ❖ In NeTeX, the PRESENTATION element can be used to set standard colours, fonts, etc for consistent presentation for zones, lines etc.
- ❖ The rows and columns of a FARE TABLE can have headings, nested recursively.
- ❖ The BRANDING element can be used to associate logos and branding names with products.
- ❖ The NOTICE element can be used to associate footnote with the cells, to the rows and columns of a fare table.

4.6.5 Visibility of underlying Tariff structures

We note that the pricing structure presented to the user may not necessarily expose the underlying fare structure use by the operator – for example:

- What are actually kilometre distance-based fares may be translated into simple point-to-point fares.
- Price groups may be used to give the same fare to many different journeys, but users will not necessarily be aware of them as they will only see the resolved prices assigned to each individual trip.
- Separately priced product elements (such as parking, a trip and travel in a destination zone) may be compounded into a single sales offer so that the underlying discrete pricing of elements is not visible.

4.7 Tariff features not relevant to UK Bus

Some common tariff features are found on other modes but are not relevant for a basic UK Bus fares. To help clarify the scope of the profile, we note here a number of key features.

4.7.1 Accommodation categories in UK bus

Fare structures often have different pricing (and pre and post-sales conditions) for different types of on-board accommodation. Buses typically offer only a single class of accommodation so distinctions between First and Second class are not relevant for tariff structures.

They are mainly relevant they are for rail networks and a few coach services.

- ❖ In NeTeX, the CLASS OF USE specifies the main categories of seating (1st class, 2nd Class etc). Additional details about accommodation (for example sleeper couchette / cabin type etc) can be specified with a FACILITY SET with ACCOMMODATION elements.
- ❖ UK  x ACCOMMODATION other reservation related parameters are not included in the FXCP fare model.

4.7.1 Facilities and Fare Products on UK bus

Certain facilities are often explicitly listed as part of a class. In some cases, they may be charged for separately as supplements (e.g. wifi), so are relevant for fare structures. For example, WIFI, power socket, beverage, meal.

- ❖ In NeTeX, a SERVICE FACILITY SET (for onboard facilities such as WIFI) or SITE FACILITY CLASS (for at stop facilities such as 1st class lounges) can be used to described groupings of facilities that are used as tariff elements.

UK  Facilities are not included as tariff elements in the FXCP fare model, but may be included as passenger information in journey definitions.

4.7.2 Other factors used in Tariff Structures

There may be other factors relevant for tariff structures, either limiting tariffs more specifically, or offering a set of prices based on a further factor (see Table 22).

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Nature	Description	Comment	Examples
Specific Journey limited (non-flexible vs flexible)	The passenger may be required to make the journey on a specific service at a certain time.	Normal for coach and fares requiring a reservation (though if a flexible fare this may be changeable). Also normal for advance fares sold at a discount to the standard fare, which require travel by a specific train. Certain tariffs may include or exclude one or more specific journeys.	❖ In NETEX the tariff may be restricted to specific journeys, or a purchase may be restricted to the service indicated by a reservation.
Quota steps	Operators may place quotas on the numbers of seats available for a specific product at a specific price.	Operators may simply wish to indicate that supply is limited i.e. quota applies (but not reveal what the specific thresholds are). In other cases, the operator may want to provide the size of the quotas and /or the different pricing steps so as to indicate the range of possible prices that may be found for a given product. Where price comparison engines are used, the quota price range may be used to populate a "Prices from x" value. May be relevant for coach or rail, not relevant for bus UK 🇬🇧 ✖ Not in FXCP fare profile	❖ In NeTeX FARE QUALITY FACTOR can be used to indicate quota steps ❖ Also, in NETEX the fare product summary conditions can indicate if a quota applies
Entitlements required (Prerequisites)	Some products may require the owner to already have another product (The prerequisite may be another fare product, or a third-party non-travel scheme (e.g. a registered disabled pass) A discount may be associated with a particular entitlement.	❖ In NeTeX stated can be stated with an ENTITLEMENT REQUIRED usage parameter.
Entitlements required (Prerequisites)	Some products may give rights to purchase specific other products, sometimes at a discount.	The entitlement may be another fare product, or a third-party non-travel scheme (e.g. a ticket to an event)	❖ In NeTeX entitlements can be stated with an ENTITLEMENT GIVEN usage parameter.
Corporate Schemes and "Frequent flier " discounts	Operators may offer a discount on price to Employers according to the	In some cases, the operator will publish a scale of prices – in others it is by negotiation.	❖ In NeTeX Can use Fare Quality Factors to define Pricing steps for

	number of Employees.		different numbers of employees. ❖ COMMERCIAL PROFILE parameter can represent employee and membership products
--	----------------------	--	--

Table 22 – Other tariff aspects of tariff structures

- ❖ NeTEx allows a number of different validity parameters (to be used in fare structures These can be used to reference network and service elements (for example, SERVICE JOURNEY, OPERATOR, TRAIN CATEGORY, etc etc.) to specify conditions and exclusions. A GENERIC PARAMETER ASSIGNMENT can be used to associate various logical combinations of conditions with specific FARE STRUCTURE ELEMENTs and VALIDABLE ELEMENTs, as well as FARE PRODUCTS.
- ❖ NeTEx also provides a general-purpose FARE QUALITY FACTOR that can be used to include any arbitrary additional quantitative or range-based criteria (such as the quota given above) in a tariff structure.

5 UK Fare Profile – Key Technical concepts

This section introduces a few key technical concepts for encoding data for the UK profile in NeTEx See Part2 for further discussion.

5.1 Use of Version Frames

The NeTEx publication XML schema is generic and can be used to exchange many different types of PT data (stops, timetables, fares, etc.) in the same document. To organise data in a modular fashion within a document, VERSION FRAMES are used. Version frames are container elements that can be used to group other related elements together. There are different content VERSION FRAMES designed for different types of data; SITE FRAMES, SERVICE FRAMES, TIMETABLE FRAMES, FARE FRAMES, etc, so that a single NeTEx document can contain data from different functional data sets. Thus, for example, a SITE FRAME, contains stop data, a TIMETABLE FRAME contains VEHICLE JOURNEYS and other timetable elements, etc.

- ❖ Frames allow defaults for certain values shared by many elements to be specified on a frame, so they don't have to be repeated on individual elements (for example currency, code space, time zone etc).
- ❖ If more than one frame is needed, either because there are different types of data or because frames are used to modularise the data, a COMPOSITE FRAME should be used to group frames together.
- ❖ A common validity condition is specified at the outermost frame level; all data in a given document should be coherent, that is self-consistent and with a common validity.

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- ❖ Frames can be marked as containing data that conforms to a specific profile (such as the FXCP) by means of a TYPE OF FRAME ELEMENT. A named set of TYPES OF FRAME for the FXCP are described in Part2 & Part3.
- ❖ The RESOURCE FRAME and the SERVICE CALENDAR FRAME are used to hold general purpose elements (OPERATORS, DAY TYPEs, etc) that apply across different functional areas. These can also be used for metadata specific to a profile, for example code values.

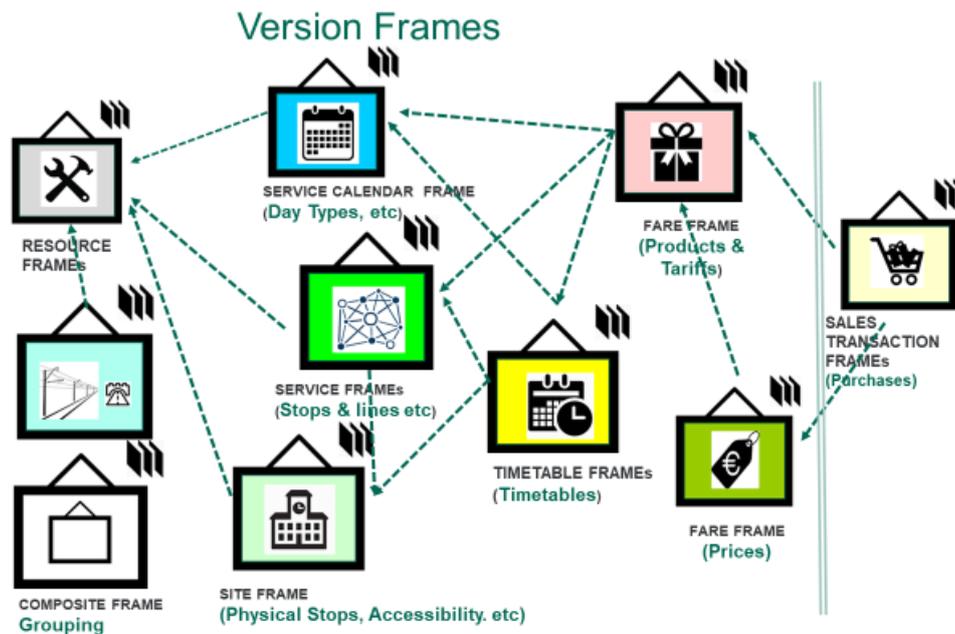


Figure 39 – Version Frame dependencies

5.2 Types of frames

VERSION FRAMEs can be given a TYPE OF VERSION FRAME to indicate that they contain content of a specific type, as agreed between data users, for example to indicate a document contains data that conforms to a national profile.

The presence of a reference to a TYPE OF VERSION FRAME gives implementers a simple way to determine whether data is intended to conform to an agreed profile – such as the UK FXCP

☞ All frames containing UK Bus fare data must be assigned one of the **standard UK Fare frame types** to indicate they contain UK profile data. See part2 and part3.

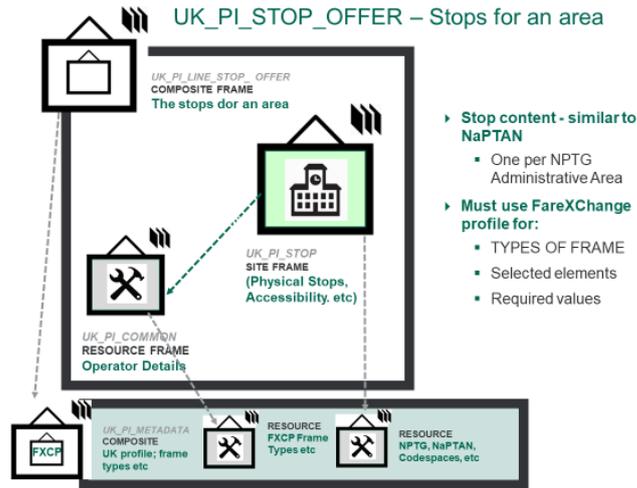


Figure 40 – FXC UK_PI_STOP frame dependencies

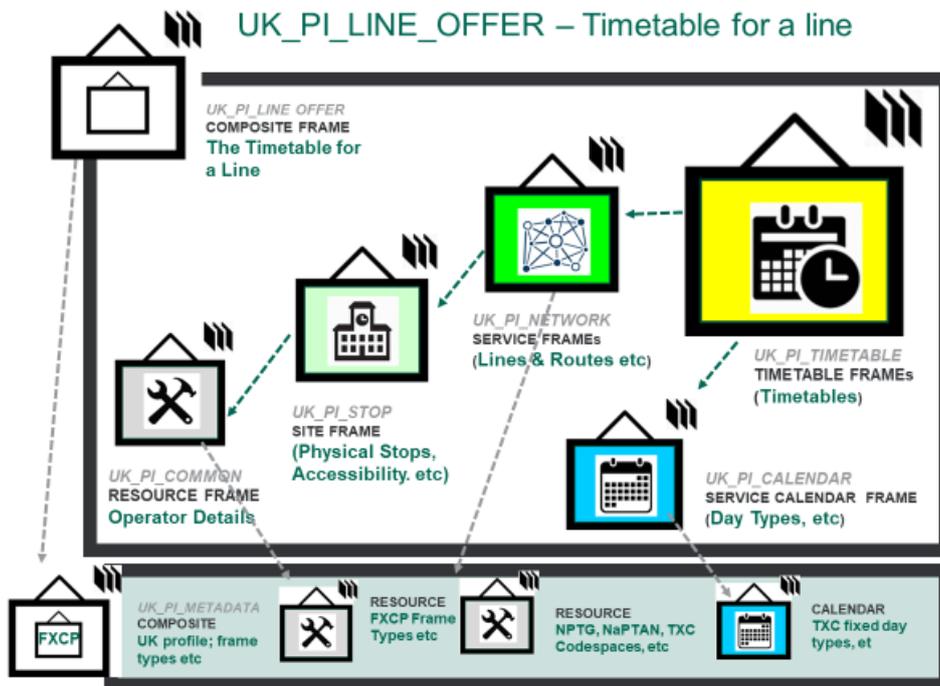


Figure 41 – FXC UK_PI_TIMETABLE frame dependencies

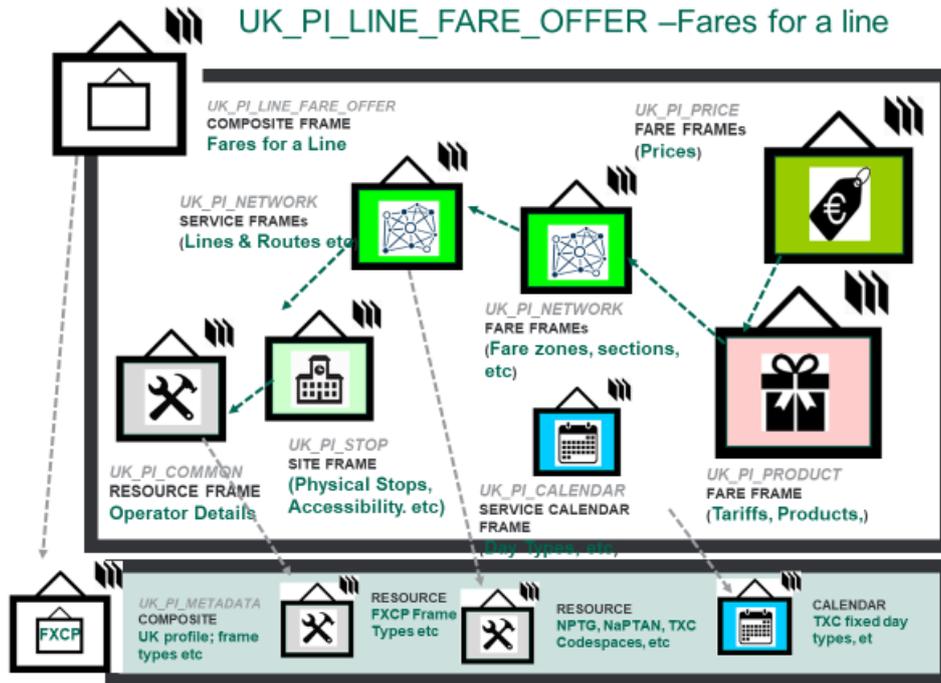


Figure 42 – FXC UK_PI_FARE frame dependencies

5.2.1 Example - Frames for a given product

To give a sense of how frames are used in the FXCP, the following shows a set of frames used to organise the fare data for a line. (the *Metrobus* Line 1 single line trip tariff). The contents of each frame are not shown.

```
<?xml version="1.0" encoding="iso-8859-1"?>
<!-- Metrobus Line 1 -->
<PublicationDelivery version="1.1" xsi:schemaLocation="http://www.netex.org.uk/netex/.J.J..xsd/NetEx_publication.xsd" xmlns="http://www.netex.org.uk/netex" xmlns:siri="http://www.siri.org.uk/siri" xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <!-- Metrobus Line 1 Example -->
  <PublicationTimestamp>2017-12-17T09:30:47.0Z</PublicationTimestamp>
  <ParticipantRef>SYS001</ParticipantRef>
  <!-- WHAT WAS REQUESTED -->
  <PublicationRequest version="1.0">
    <PublicationRefreshInterval>P1M</PublicationRefreshInterval>
    <Description>Example of simple point to point fares</Description>
  </PublicationRequest>
  <!-- RESULTS -->
  <dataObjects>
    <CompositeFrame version="1.0" id="epd:UK:METR:CompositeFrame_UK_PI_LINE_FARE_OFFER:Trip@Line_1" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.tariffs">
      <ValidBetween>
        <FromDate>2017-01-01T00:00:00</FromDate>
        <ToDate>2020-12-31T12:00:00</ToDate>
      </ValidBetween>
      <Name>Metrobus 1 0 - Fares Example</Name>
      <Description>This is an example showing how one might encode the basic matrix Metrobus 1 fare table tin NetEx. This is a stripped down version. For a fuller example see related file <Description>
      <TypeOfFrameRef ref="fxc:UK:DFT:TypeOfFrame_UK_PI_LINE_FARE_OFFER:FXCP" versionRef="fxc.v1.0"/>
      <!-- CODESPACES -->
      <codespaces>
        <!-- FRAME DEFAULTS -->
        <FrameDefaults>
          <!-- The default means that actually we could leave off all id's that belong to the mb: namespace. -->
          <DefaultCodespaceRef ref="mb_data"/>
        </FrameDefaults>
        <prequisites>
        </prequisites>
        <frames>
          <!-- FAREs -->
          <FareFrame version="1.0" id="epd:UK:METR:FareFrame_UK_PI_FARE_PRODUCT:Trip@Line_1.mb" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.tariffs">
            <FareFrame version="1.0" id="epd:UK:METR:FareFrame_UK_PI_FARE_PRICE:Trip@Line_1.mb" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.tariffs">
              <!-- NETWORK -->
              <FareFrame version="1.0" id="epd:UK:METR:FareFrame_UK_PI_FARE_NETWORK:Line_1.mb" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.network_data">
                <SiteFrame version="1.0" id="epd:UK:METR:SiteFrame_UK_PI_NETWORK:Crawley:nptg" responsibilitySetRef="nptg_data" dataSourceRef="nptg.dft">
                  <ServiceFrame version="1.0" id="epd:UK:METR:ServiceFrame_UK_PI_NETWORK:Line_1.mb" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.tariffs">
                    <!-- OPERATOR COMMON RESOURCES -->
                    <ResourceFrame version="1.0" id="epd:UK:METR:ResourceFrame_UK_PI_COMMON:Metrobus:mb" dataSourceRef="mb.metrobus" responsibilitySetRef="mb.network_data">
                    </ResourceFrame>
                  </ServiceFrame>
                </SiteFrame>
              </FareFrame>
            </FareFrame>
          </frames>
        </CompositeFrame>
        <!-- COMMON UK FARE RESOURCES -->
        <CompositeFrame id="fxc:UK:DFT:TypeOfFrame_UK_PI_METADATA_OFFER:FXCP:fxc" version="fxc.v1.0" responsibilitySetRef="fxc:Fxc_metadata" dataSourceRef="fxc.dft">
        </CompositeFrame>
      </dataObjects>
    </PublicationDelivery>
```

Figure 43 Example of fare frames used to group a product

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In the above example

Container

- A COMPOSITE FRAME of type 'UK_PI_FARE_PRODUCT_OFFER' is used to group the other frames.

Products:

- A FARE FAME of type 'UK_PI_FARE_PRODUCT' is used to hold the specification of the fare products.
- A separate FARE FAME of type 'UK_PI_FARE_PRICE' is used to hold the fare prices for the product

Network

- A FARE FAME of type 'UK_PI_FARE_NETWORK' is used to hold group elements specifying how the network elements may be accessed in the fare products.
- A SERVICE FRAMES of type 'UK_PI_NETWORK' is used to declare which Network elements (LINES, SERVICE PATTERNS, etc) are to be used in the 'UK_PI_FARE_NETWORK' frame. The same frame may be used in different products.
- A SITE FRAME of type 'UK_PI_STOP' is used to declare which stops are to be used in the 'UK_PI_NETWORK' frame. The same frame may be used in different products.
- A RESOURCE FRAME of type 'UK_PI_COMMON' is used to declare common components such as the OPERATOR that are used in the other frames. The same frame may be used in many different products.

5.3 Granularity of data

In organising data for exchange between systems, an important question is – what is the useful granularity of data? That is, to what extent should data be broken down into individual files, or be aggregated into fewer larger files? The answer necessarily depends on the complexity and volume of the data as well as the way in which it changes over time. It also depends on whether it comprises a self-contained document with a particular use, or is only useful in an aggregated form. This can be seen by considering existing UK PT data sets. Thus, for example, NPTG locality data is in a single document (a small, fairly static data set compiled from a single central source). NaPTAN stop data (a large data set collected regionally and changing occasionally) is available as a separate file for each administrative area. TransXChange timetable data (a very large data set that changes periodically) is distributed as a single document for each individual service (though current registration practices sometimes distort this a little). It is important both to keep documents down to a manageable size and to reflect their use within a workflow (for example changing the timetable for an operator should not require the reprocessing of other unaffected timetables).

Depending on the nature of the product, fare data may need to be exchanged either for an area (as say a NaPTAN administrative area) or by operator and line (as for a TransXChange service). There may be multiple tariffs that apply, some line or operator specific, and some applying to larger areas of the network or multiple operators. (For example, network passes) There is also the question as to how much of the data to describe the network should be included with the fare data and how much should be exchanged separately. (Just as say, a TransXChange document contains basic information about a stop such as its name in order to print a timetable, but doesn't include the full NaPTAN and NPTG data set for the stops).

UK  Based on these considerations, the following granularity for UK fare data is proposed:

- ❖ There should be a separate fare document for each service (i.e. LINE), corresponding to the 'Service' of a TransXChange timetable. This should include all fares specific to the lines for a specific product type with a specific tariff structure (Typically either point-to-point, or fare

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stage, or flat), and external references to any general products (zonal passes, carnets etc) that also cover the line.

- ❖ There should be a separate fare document for each general product set (zonal passes, network flat fares, etc) for each operator or network.
- ❖ For large multi-operator schemes (e.g. Plusbus, national concessionary scheme, etc) there should be a document describing the core product, and then separate documents for each operator describing local inclusions and exclusions.
- ❖ Where there is a large network, it can be broken down into separate document by region.
- ❖ Price data should be placed in separate frames from the fare product specification. In some cases, it may be desirable to place price data in a separate document to the fare structure: the structure will be relatively static; the prices will change over time.
- ❖ The UK fare profile does not cover Sales Transaction data recording the sale of products (although this can be described by NeTEx)

These principles are elaborated further in the FXCP part 2 and part 3 documents, along with a set of naming conventions for the documents.

5.4 Use of Identifiers

This section describes principles for using identifiers for the FXCP.

5.4.1 Codespaces

All elements in a NeTEx document are given a persistent identifier from a nominated **codespace**. The codespace provides a globally unique context that ensures data elements can be referenced uniquely regardless of their origin. It also enables a distributed data management process whereby the allocation of codes is delegated to individual data suppliers and does not require a central authority to act as a code registrar.

- ❖ A codespace corresponds to a W3C domain, (as in a 'URL', whose root is formally established as globally unique by registering a domain name with IANA). The identity scheme used within a codespace is arbitrary; it is up to the codespace owner to ensure that all elements within the scheme are unique and persistent. For example, UK NaPTAN codes use a multipart identifier that encodes an area code prefix and a suffix that depends on the stop type.
- ❖ A codespace can be assigned a short prefix in a given document, for example '*naptStop:*' to assign www.naptan.org.uk/stops/.
- ❖ Codespaces are declared at the start of a VERSION FRAME and apply to the frame and any nested frames.
- ❖ Data from multiple codespaces can be mixed in the same document.
- ❖ A default codespace can be specified for a frame which can be assumed if no codespace is specified on an element.
- ❖ The codespace may indicate to a consumer that there are further rules for the format of an identifier (e.g. as to length and characters allowed); however, the actual rules themselves are outside of the scope of NeTEx and must be implemented by agreement. For example,

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the NaPTAN stop code has a particular format (prefix = type + suffix) that can be associated with a NaPTAN code space.

- ❖ A given codespace may cover a number of different types of element; it is also possible for an operator to use multiple codespaces.
- ❖ A codespace applies to the *id* attribute, and to references to the id from other elements.

Codespaces can be assigned to existing UK data sets, as well as to each operator and other provider of data. See part2 and Part3.

5.4.1.1 Example XML snippet – declaring code spaces

The following XML snippet shows declarations of three code spaces, with prefixes, *naptStop*, *noc* and *mb*. One of them, *mb*, is set as a default

```
<Codespace id="naptStop_data">
  <Xmlns>naptStop</Xmlns>
  <XmlnsUrl>http://www.naptan.org.uk/stops</XmlnsUrl>
  <Description>NaPTAN Stops</Description>
</Codespace>

<Codespace id="noc_data">
  <Xmlns>noc</Xmlns>
  <XmlnsUrl>http://www.traveline.co.uk/noc</XmlnsUrl>
  <Description>UK National operator codes</Description>
</Codespace>

<Codespace id="mb_data">
  <Xmlns>mb</Xmlns>
  <XmlnsUrl>http://www.metrobus.co.uk/</XmlnsUrl>
  <Description>Metrobus data </Description>
</Codespace>
```

5.4.1.2 Example XML snippet – Identifiers

The following XML snippet shows element identifiers that use the different code space prefixes shown above to set codespaces for their identifiers. If the codespace is the default for the frame (as in the case of *mb* above) the prefix can be omitted.

Declaration of an operator using the National Operator code;

```
<Operator id="noc:FBRI" version="1.1">
```

Reference to the same operator using the National Operator code;

```
<OperatorRef ref="noc:FBRI" version="1.1">
```

Reference to a NaPTAN Stop;

```
<ScheduledStopPointRef ref="naptStop:4400CY0073" version="3.2"/>
```

Declaration of a tariff for metrobus;

```
<Tariff id="mb:Metrorider" version="any">
```

Reference to a tariff for metrobus (assuming a codespace default prefix of *mb*);

```
<TariffRef ref="Metrorider" version="any">
```

5.4.2 UK Code spaces

For UK fare data, some elements (e.g. NaPTAN stops, NPTG Locations, etc) come from existing national data sets that have existing well-defined public code spaces. Most other data elements come from an operator and the choice of a code system and allocation of codes will be according to the operator's own internal system, i.e. fall within an operator codespace. The operator themselves should be identified by a traveline NOC code.

A set of codespaces for UK data is given in part2 (FXCP-NT)..

5.4.2.1 Operator codespaces

Operators (and other data suppliers) may choose their own identifier coding system for their fare data elements, as indicated by one or more **codespaces** specified in their FXCP compliant documents.

In order to contribute data in a NeTeX format that can be integrated into a larger data set, the operator must ensure that the identifiers of any data provided are unique within their chosen codespace or codespaces.

Operators may choose to have a single codespace for several different elements (providing the types do not clash), or may prefer to have different namespaces for different element types:

For example using different namespaces for different element types:

```
scb:   SucuBuses.co.uk/
```

For example using different namespaces for different element types:

```
scbT   SucuBuses.co.uk/timetables/  
scbL   SucuBuses.co.uk/lines/  
scbF   SucuBuses.co.uk/tariffs/  
scbP   SucuBuses.co.uk/prices/  
Etc etc
```

5.5 References

When a complex data set is serialised as an XML document, it will include references to link the different elements together. For example, a NaPTAN stop specifies a reference to an NPTG Locality. In NeTeX these references can either be **internal** – to an element specified elsewhere within the same document, or **external** – to an element in another document.

NeTeX allows an implementor to decided which references should be internal (and be validated automatically) and which are external. This flexibility allows different modularisations of data to be made to suit different workflows and enables largescale deployments of data.

Modularising ; references may be internal or external

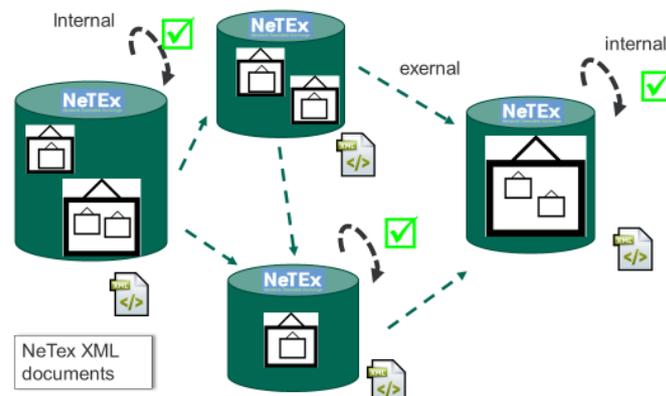


Figure 44 – Internal and external references

5.6 Use of Common Code values

In order to standardise data, the code values used to classify and categorise data are constrained to common code sets wherever possible. NeTEx uses two different mechanisms for such values, both of which allow for automatic validation to ensure only legitimate values are used.

- ❖ **Enumerated values:** For data values with a small list of values for which there is a common consensus for standardisation, XML enumerations are used for such values which will be automatically checked by any XML validator to be used. For example, the days of the week can be validated as being one or more of *Monday, Tuesday, Wednesday*, etc
- ❖ **Open code sets.** Some sets of code values depend on national or local requirements or must reflect usage in a specific implementation. It is nonetheless desirable that they be restricted to a limited list of values. Such values can be represented by defining Specific “TYPE OF ENTITY” elements, which can then be referenced where a code value

UK[☞] Enumerated values to be used are indicated in the profile

UK[☞] Open code set Code values to be used are indicated in the profile.

UK[☞] In order to standardise common UK open code values, common values for UK national use are encoded in a set of “Metadata” resource frames that can be included in all UK XML fare documents. Tariff data should reference these values to ensure that valid code values are valid.

UK[☞] Data elements must reference only the standard values as defined in the UK Fare Resource Frame.

6 Scoping Examples

The FXCP project has developed several XML examples based on different published tariffs and fare products for UK bus operators as described online. The examples are intended to range from simple single operator products to complex multi-operator offerings and cover the tariff and fare product types described earlier in this document.

The examples are encoded as FXCP compliant XML documents, using NPTG and NaPTAN stop data where relevant and organised within version frames each assigned to a FXCP TYPE OF FRAME.

Each example is contained in a single XML document, organized internally with NeTEx version frames that group data into related sections.

The examples are proof of concept 'skeletons'; they are populated only with a bare bone set of instance data to illustrate the use of NeTEx and do not constitute a full data set. For some of the examples there are two or more variant encodings showing minimum and richer representations of the same tariff.

The purpose of the examples in this document is threefold:

- To illustrate the scope of the FXCP with some concrete examples.
- To give the general reader a sense of how any sort of fare can be constructed from the common set of NeTEx components.
- To give developers and technical readers an overview of how to use the components in the FXCP part3 to represent different types of common fares (and to act as an introduction to the XML examples).

6.1 Example 1: Zone-to-Zone Fares (Metrobus1)

A common classical bus tariff is to charge for each individual trip, with specific prices to travel between either two any points or any two zones. Such a fare can be presented as a table of origins and destinations. If the fares are symmetric - the same in both directions – only half the table need be shown – sometimes referred to as a “Fare triangle”

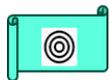
The example encodes the fare sheet for the *Metrobus* “Line 1” service, as published online. The fare sheet presents the fares as a triangle of zone-to-zone prices, where each zone is a group of stops. For the purposes of demonstration we will treat this as a zone to-zone tariff structure (though a close inspection of the actual prices hints perhaps that internally, Metrobus derive the fare sheet from a fare stage tariff model that charges £1.60 for a single stage and £2.40 for two or more stages – such a model could be represented with just two prices and 10 fare stages with no need for zones.).

6.1.1 Key features

- Zone-to-zone tariff.
- Single trip.
- Adult and child user types.
- Single media, paper ticket.
- On board cash sale.

The child prices can be derived from the adult prices.

6.1.1 FXCP Scope



Basic fare profile.

6.1.2 Fare Sheet

Metrobus publish fare sheet for walk on fares as follows:



1

**Crawley Area Metrorider
Metrovoyager
Discovery Ticket
Gatwick Travelcard**
Accepted throughout.

PlusBus
Crawley, Three Bridges, Gatwick Airport, Ifield and Horley PlusBus tickets are valid throughout. Please see www.plusbus.info for further information.

Concessionary Passes
Concessionary passes are valid throughout from 0930-2300 Mon-Fri, and anytime at weekends and public holidays.

Bewbush West - Crawley - Broadfield/Pease Pottage

Adult Single Fares

Bewbush West (loop)					
160 Bewbush Neighbourhood Centre					
240 160 Gossops Green Shops					
240 240 160 West Green Crawley Hospital/Apple Tree					
240 240 240 160 Crawley Town Centre					
240 240 240 240 160 Southgate Avenue North					
240 240 240 240 240 160 Southgate Wensleydale					
240 240 240 240 240 240 160 Broadfield (all stops)					
240 240 240 240 240 240 240 160 Pease Pottage Black Swan					

Fares are shown in pence. Eg. 170 = £1.70

To calculate your fare, find your location, and your destination, where the row and the column cross is your fare.

Return Fares
Not available on this service.

Child Fares
Child Fares are available on this route at half the adult fare on single journeys.

24.01.17 Metrobus Ltd, Wheatstone Close, Crawley, West Sussex, RH10 9UA. Tel: 01293 449191



Figure 45 Example – Metrobus Line 1 – Fare sheet

6.1.3 Route Map

6.1.3.1 Published Route Map

Line 1 runs over a route between Bewbush and Broadfield and includes an interchange at Crawley Rail station

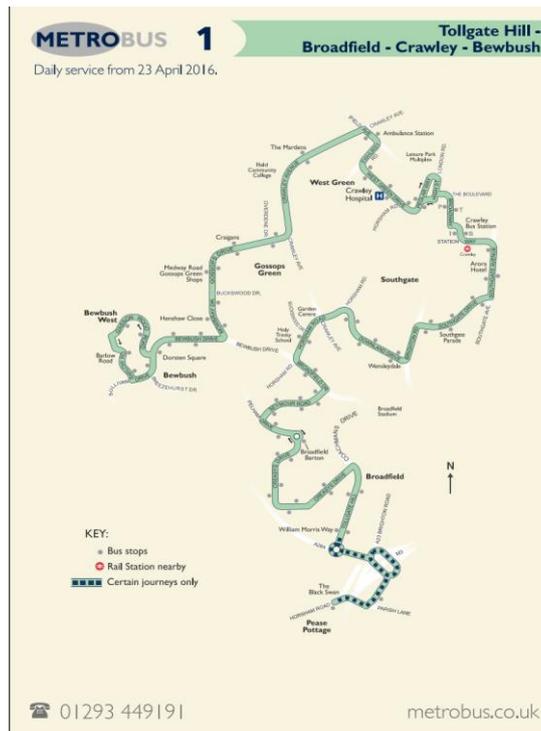


Figure 46 Example – Metrobus Line 1 – Route Map

6.1.3.2 Route Map with NeTEx elements

The main NeTEx element used to represent the route structure can be identified on the route map.

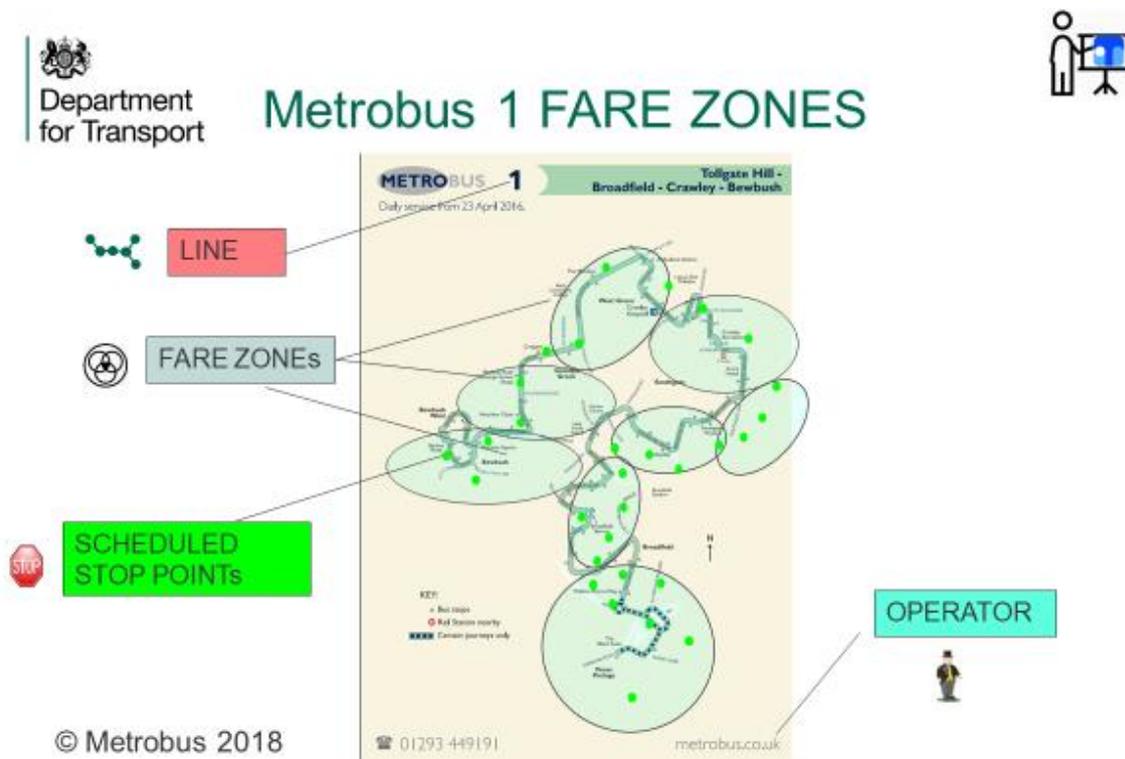


Figure 47 Example – Metrobus Line 1 Route – NeTEx component use

UK Bus Fares Profile

There is a single SALES OFFER PACKAGE, offering the single PREASSIGNED FARE PRODUCT, with a TYPE OF DOCUMENT paper ticket available through a DISTRIBUTION CHANNEL on-board or at stops where there is a machine.

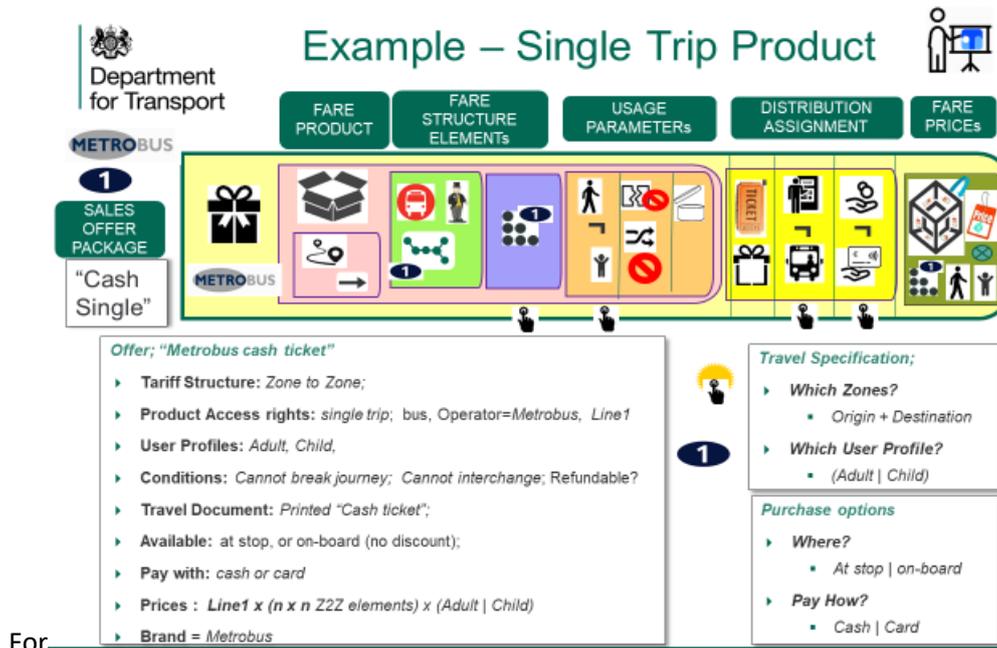


Figure 49 Example - Metrobus Line 1 – Offer Summary

6.1.1 Price Table

There are FARE PRICES for each combination of DISTANCE MATRIX ELEMENT and USER PROFILE.

- DISTANCE MATRIX ELEMENT x USER PROFILE

6.1.2 Further discussion

The price of a child fare is not given as an actual value on the fare sheet, but rather stated as being derived from the adult fare.

Derived prices are not included in the basic fare profile, so an additional set of prices for a child USER PROFILE would need to be computed and exchanged explicitly.

In the extended FXCP, a PRICING RULE can be used to specify a FARE PRICE that is derived from the adult price. Only the rule and the necessary pricing parameters needs to be exchanged.

6.2 Example 2: Period Pass Fares (Metrorider)

For regular users of bus services, it is common to offer period passes that allow unlimited use of certain services for a specific period, ranging from a number of minutes to a number of years. Usually access rights are defined zonally, though they may alternatively be limited to a specific line or a specific origin and destination (as for some rail season passes and plus bus addons).

The Metrobus *Metrorider* example below encodes a zonal tariff with products that give access to a zone for a specified duration, ranging from 60 minutes to a year.

6.2.1 Key Features

- Zonal tariff (nested Zones).
- Day Passes: day, evening and 60m passes.
- Season Passes for varying periods.
- Multiple user types (Adult, child, student).
- Multiple media with different pricing (paper, smartcard, mobile app).
- Group (family and duo) tickets and discounts.

6.2.2 FXCP Scope



Basic fare profile

Note that season passes may have a number of complex additional conditions (e.g. for subscribing, partial refunds, etc.) that may be described quantitatively in NeTEx but are outside of the scope of the basic fare profile.

6.2.3 Fare sheet

The following fare sheet presents the tariff for the *Metrorider* passes (Note that a separate multi-trip carnet product that uses the same FARE ZONES is shown on the right - see example 4).

UK Bus Fares Profile

	bought on bus with cash				stored on your mobile phone as m-tickets										loaded onto our smartcard the key									
Crawley Metrorider	Unlimited travel in the Crawley Metrorider area.				Unlimited travel in the Crawley Metrorider area.										Unlimited travel in the Crawley Metrorider area.									
	1 day	1 week	Evening		60 minute	1 day	2 day#	3 day#	1 week	4 week	Duo		Evening		1 day	1 week	4 week	13 week	Annual	Evening		5 journeys	10 journeys	25 journeys
Adult	£4.90	£20	£4		£2.20	£4.20	£7.90	£11.50	£18	£59	£7.90		£3.70		£4.20	£18	£59	£154	£520	£3.70		£11	£21	£50
Child	£2.70	£11	-		£1.10	£2.35	£4.45	£6.45	£9.75	£32.50	-		-		£2.35	£9.75	£32.50	£79	£290	-		£5.50	£10.50	£25
Student	-	-	-		-	-	-	-	-	-	-		-		£3.15	£13.50	£44.25	£115.50	£390	-		-	-	-
Family*	£9	-	-		-	£9	-	-	-	-	-		-		-	-	-	-	-	-		-	-	-
	* All day travel for up to 5 people (minimum of 1 adult & maximum of 2 adults travelling at any one time). ** Available from 1800 and valid until 0359 on the following day. *** For 2 adults, travelling together.														Multi Trip single journeys grouped onto the key to use one at a time.									
Horsham Metrorider	Unlimited travel in the Horsham Metrorider area.				Unlimited travel in the Horsham Metrorider area.										Unlimited travel in the Horsham Metrorider area.									
	1 day	1 week			60 minute	1 day	2 day#	3 day#	1 week	4 week	Duo				1 day	1 week	4 week	13 week	Annual			5 journeys	10 journeys	25 journeys
Adult	£4.90	£20			£2.20	£4.20	£7.90	£11.50	£18	£59	£7.90				£4.20	£18	£59	£154	£520			£11	£21	£50
Child	£2.70	£11			£1.10	£2.35	£4.45	£6.45	£9.75	£32.50					£2.35	£9.75	£32.50	£79	£290			£5.50	£10.50	£25
Student	-	-			-	-	-	-	-	-					£3.15	£13.50	£44.25	£115.50	£390			-	-	-
Family*	£9	-			-	£9	-	-	-	-					-	-	-	-	-			-	-	-
	# Consecutive days. * All day travel for up to 5 people (minimum of 1 adult & maximum of 2 adults travelling at any one time). ** For 2 adults, travelling together.																							
Redhill & Reigate Metrorider	Unlimited travel in the Redhill & Reigate Metrorider area.				Unlimited travel in the Redhill & Reigate Metrorider area.										Unlimited travel in the Redhill & Reigate Metrorider area.									
	1 day	1 week			60 minute	1 day	2 day#	3 day#	1 week	4 week	Duo				1 day	1 week	4 week	13 week	Annual			5 journeys	10 journeys	25 journeys
Adult	£4.90	£20			£2.20	£4.20	£7.90	£11.50	£18	£59	£7.90				£4.20	£18	£59	£154	£520			£11	£21	£50
Child	£2.70c	£11c			£1.10	£2.35	£4.45	£6.45	£9.75	£32.50					£2.35	£9.75	£32.50	£79	£290			£5.50	£10.50	£25
Family*	£9	-			-	£9	-	-	-	-					-	-	-	-	-			-	-	-
	c Sunny Student card holders can purchase Child rate tickets for cash on the bus, or students can purchase a Child Metrovoyager (on the key only) for longer validity tickets. See below for prices. * All day travel for up to 5 people (minimum of 1 adult & maximum of 2 adults travelling at any one time). ** For 2 adults, travelling together.																							
Metrovoyager	This ticket bought on the bus gives you unlimited travel on all of our services across our entire network, including both the Crawley, Horsham, and Redhill & Reigate Metrorider areas. Also valid on all Brighton & Hove bus services.				This ticket bought on the bus gives you unlimited travel on all of our services across our entire network, including both the Crawley, Horsham, and Redhill & Reigate Metrorider areas. Also valid on all Brighton & Hove bus services.										This ticket bought on the bus gives you unlimited travel on all of our services across our entire network, including both the Crawley, Horsham, and Redhill & Reigate Metrorider areas. Also valid on all Brighton & Hove bus services.									
	1 day	1 week			1 day	2 day#	3 day#	1 week	4 week					1 day	1 week	4 week	13 week	Annual						
Adult	£7.40	£25			£6.70	£12.50	£18.20	£24	£85					£6.70	£24	£85	£250	£870						
Child	£4.20	£16.50			£3.80	£6.90	£10.10	£15.75	£52					£3.80	£15.75	£52	£153	£610						
Student	-	-			-	-	-	-	-					£5.05	£18	£63.75	£187.50	£652.50						
Family*	£12.50	-			£12.50	-	-	-	-					-	-	-	-	-						
	# Consecutive days. * All day travel for up to 5 people (minimum of 1 adult & maximum of 2 adults travelling at any one time).														Multi Trip is available in the separate Metrorider areas only.									

Figure 50 Example – Metrobus Metrorider Fare sheet

6.2.4 Price Table

There are separate FARE PRICES for each permitted combination of SALES OFFER PACKAGE (i.e. FARE ZONE and TYPE OF TRAVEL DOCUMENT) with each TIME INTERVAL and each USER PROFILE or GROUP TICKET. Not all combinations are allowed.

Zonal Fare

- (SALES OFFER PACKAGE / FARE ZONE) x TIME INTERVAL x (USER PROFILE | GROUP TICKET)

6.2.4.1 Product / Zone / Media offer combinations

The twelve different SALES OFFER PACKAGES, all based on the same FARE PRODUCT are summarised in the following diagram, along with the parameters relevant for pricing.

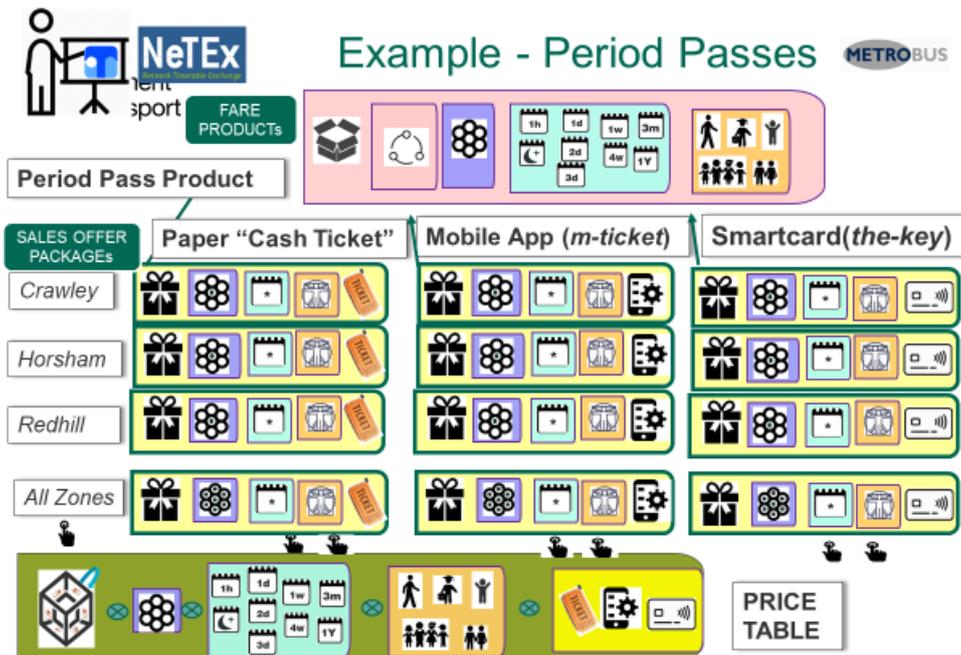


Figure 51 Example – Metrorider – Summary of offer

6.2.4.2 Product / Zone / Cash ticket offer combinations

SALE OFFER PACKAGES can add further restrictions. For example, only certain combinations of duration and user profile are available for walk up paper tickets, and student discounts are available on for the Horsham zone.

For example, the TIME INTERVAL can only be 1 day or 1 week. Specific

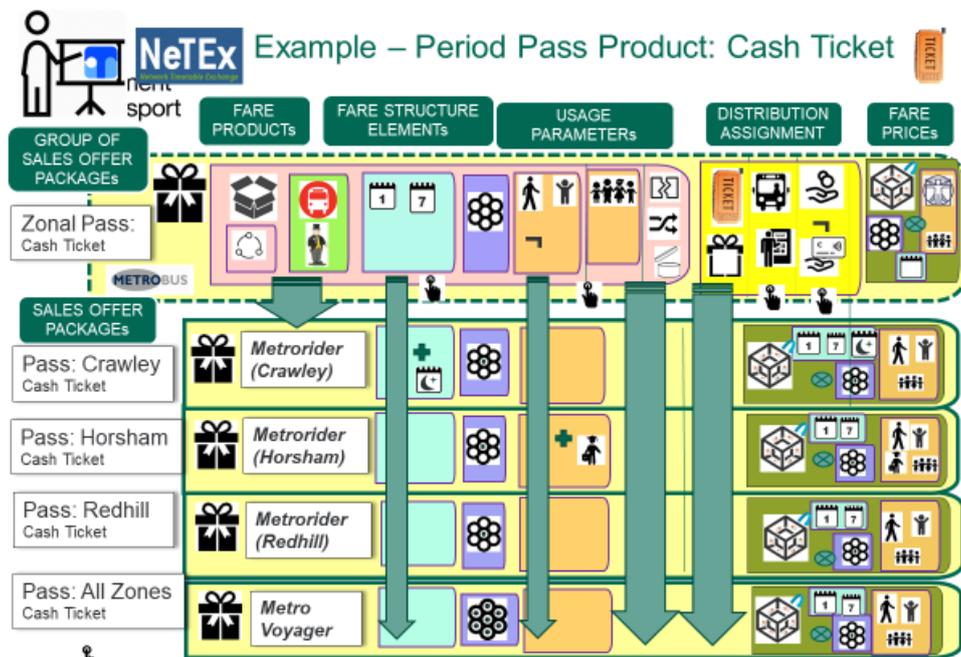


Figure 52 Example – Metrorider – Summary of Cash ticket offer

6.2.4.3 Product / Zone / Mobile App offer combinations

More combinations of duration and user profile are available for mobile apps and cheaper prices are offered.

UK Bus Fares Profile

The SALES OFFER PACKAGES can specify additional TIME INTERVAL for both shorter and some longer period options, as well as GROUP TICKET options for couples (“duo”) to travel at a discount

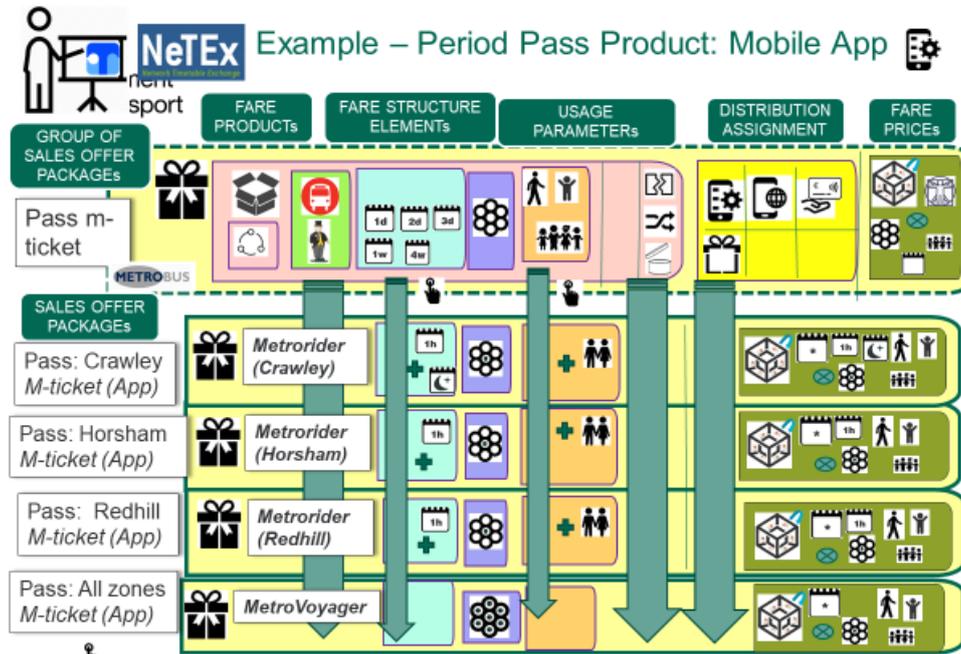


Figure 53 Example – Metrorider – Summary of Mobile app offer

6.2.4.4 Product / Zone / Smartcard offer combinations

The different combinations of longer duration and user profile are also available on a smartcard and cheaper prices are offered. Annual tickets (with a TIME INTERVAL of 1 year) are only available on a smartcard. VALIDITY PARAMETER ASSIGNMENTS can be used to add the required specific conditions to each SALES OFFER PACKAGE.

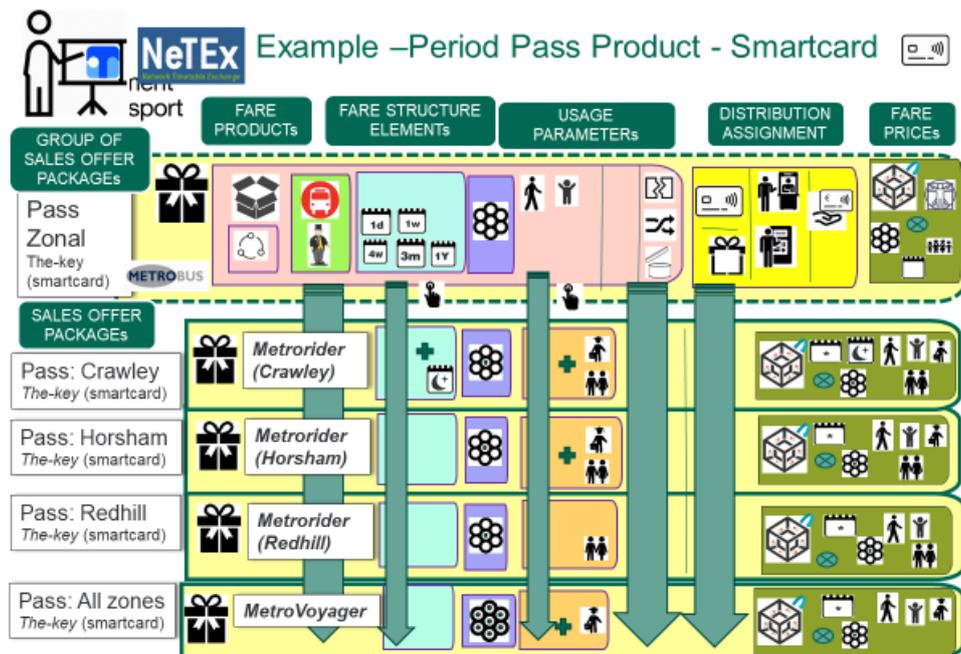


Figure 54 Example – Metrorider – Summary of Smartcard offer

6.2.5 Zone map

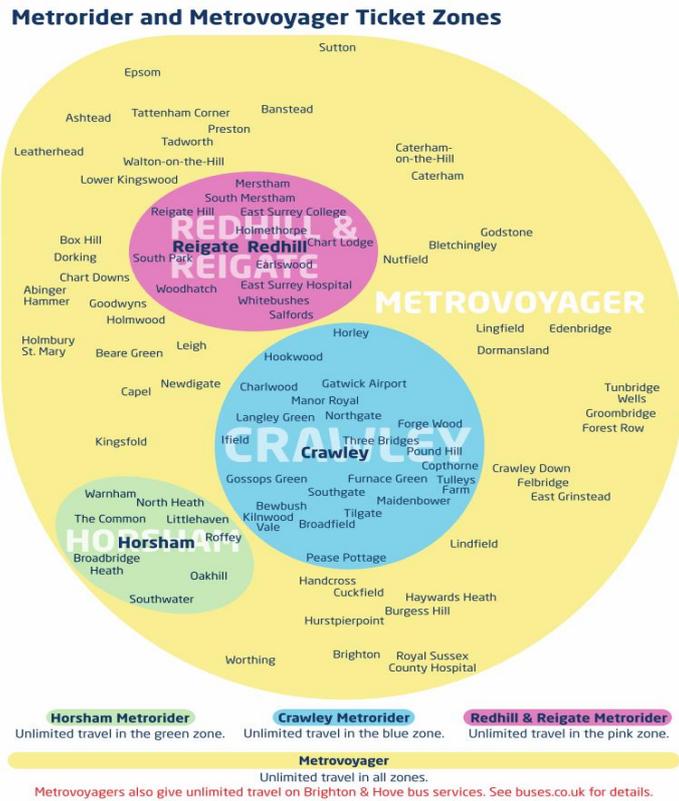


Figure 55 Example – Metrobus Metrorider Fare Zones

Nested Fare Zones - Metrorider & Metrovoyager

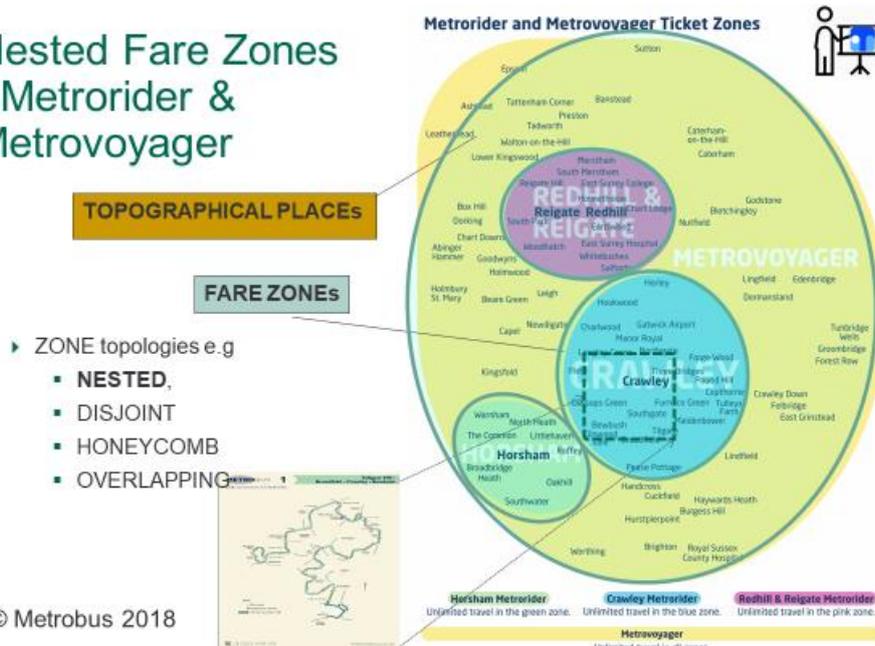


Figure 56 Example – Metrobus Metrorider Network – NeTeX components

6.2.1 Component Use

The main NeTEx element used to represent the Tariff structure can be identified on the sheet as shown below:

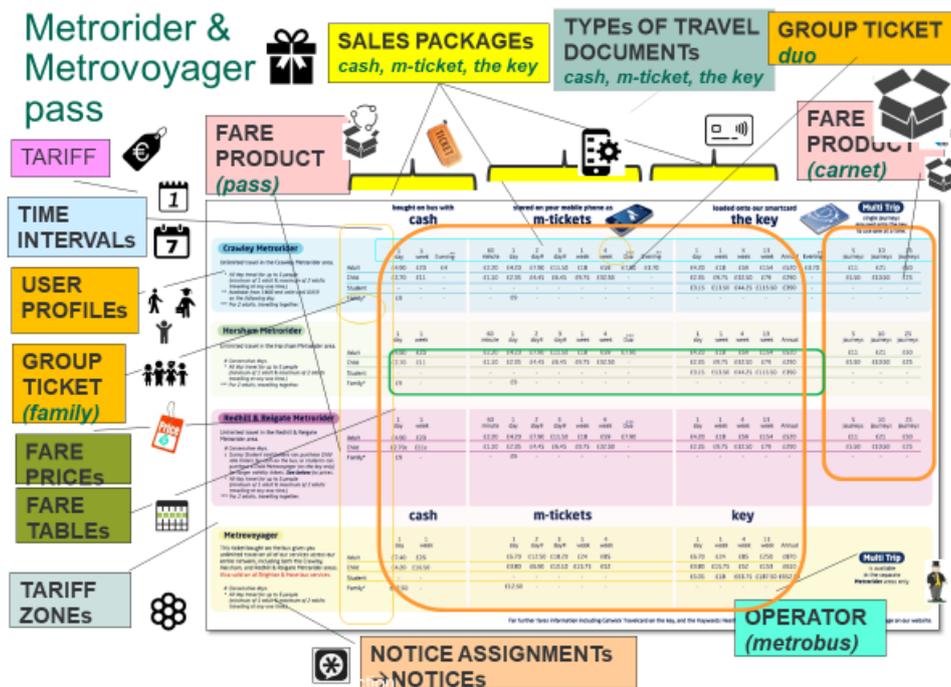


Figure 57 Example – Metrorider – Component use

6.2.2 Product Summary

We can summarise the overall composition of the *Metrorider* Tariff in NeTEx components as shown in the figure below.

The network comprises three individual FARE ZONES nested within an overall zone.

There is a single PREASSIGNED FARE PRODUCT, defining a period pass that give access rights for unlimited travel in one of the different fare zones for the duration of several different TIME INTERVALS.

The TARIFF references the set of FARE ZONES, one of which may be selected.

The TARIFF includes TIME INTERVALS, one of which may be selected. There are intervals both for day and season passes of specific length (1 week, 1 month, 3 months etc), but also for some short term (e.g. 60 minute, evening, etc) passes that are available for some but not all of the zones.

The tariff structure also includes three separate USER PROFILES for adults, children and students, one of which may be selected.

The tariff structure also includes separate GROUP tickets for families and couples, one of which may be selected in place of a USER PROFILE.

There are USAGE PARAMETERS to define the conditions on travel; INTERCHANGING (allowed), FREQUENCY (unlimited). These are fixed and apply always.

The PREASSIGNED FARE PRODUCT has a VALIDABLE ELEMENT giving access rights to travel in a ZONE, for a single USER PROFILE and or GROUP TICKET, and subject to the travel conditions.

UK Bus Fares Profile

Three different types of ticket media (TYPE OF TRAVEL DOCUMENT) are available; paper, mobile app and smartcard, each associated with different payment methods, DISTRIBUTION CHANNELS, FULFILMENT METHODS, and prices.

There are twelve SALES OFFER PACKAGES, all using the same PREASSIGNED FARE PRODUCT for a period pass, but each specifying a particular FARE ZONE and choice of media (TYPE OF TRAVEL DOCUMENT) and with slightly different additional conditions (thus 4 zones x 3 TYPES OF TRAVEL DOCUMENT). Each package is available for a specific set TIME INTERVALS – the short interval of 60minutes and the evening one are only available for particular zones.

6.2.1 Further discussion

Season passes are more expensive than single trips and may have more elaborate commercial conditions associated with them. NeTEx represents them as USAGE PARAMETERS, for example

- PURCHASE WINDOW – how long in advance they may be purchased,
- EXCHANGING & REFUNDING: there may be precise rules for partial refunds,
- REPLACING: Fees and condition for replacing lost passes.
- SUBSCRIBING. Products may offer reduced rates for payment by subscription.

UK  Additional parameters that are material to the pricing factors are not required by the basic profile.

6.3 Example 3 Unit Section Fare (First Bristol)

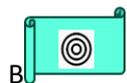
The unit section example encodes the fare sheet for a First West of England service, as published online. The fare sheet presents the fares as a series of zone sections, with prices depending on the number of zones consumed, but not on any particular route. The stage fares apply outside of the city zones for Bath, Bristol and Weston-super-mare.

6.3.1 Key features

- Stage / Unit section tariff.
- Single trip on a specific line (Lien 48 in Bristol).
- Adult, youth and child user types.
- Both paper ticket and mobile app media.
- On board cash sale and online.

The child prices can be derived from the adult prices.

6.3.2 FXCP Scope



Basic fare profile.



Figure 58 Example – West of England pass – Zone map

6.3.3 Fare Sheet

First West of England publish fares for section on fares as follows:

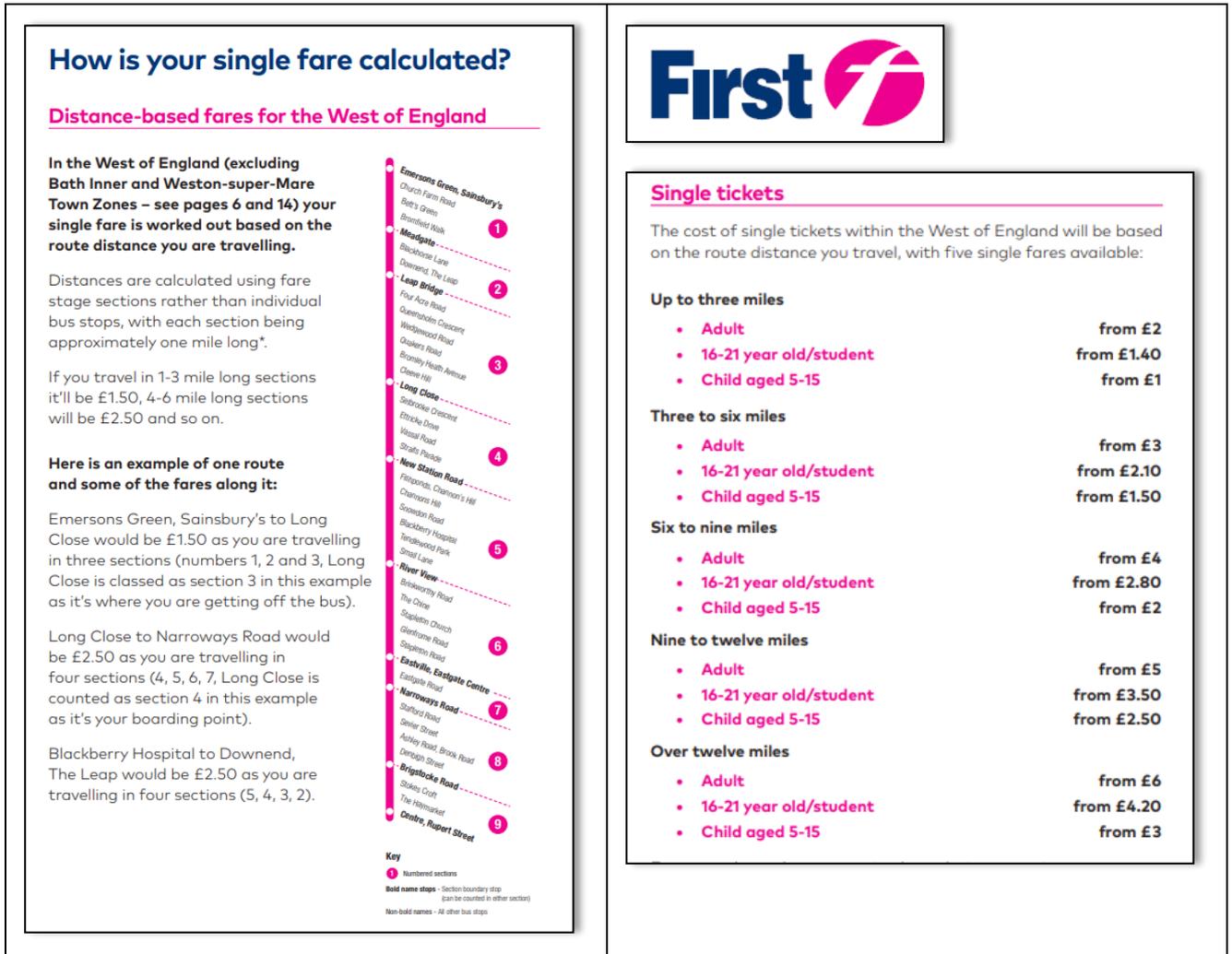


Figure 59 Example – First West Of England Section – Fare sheet

6.3.4 Component Use

The main NeTex element used to represent the Tariff structure can be identified on the sheet as shown below:

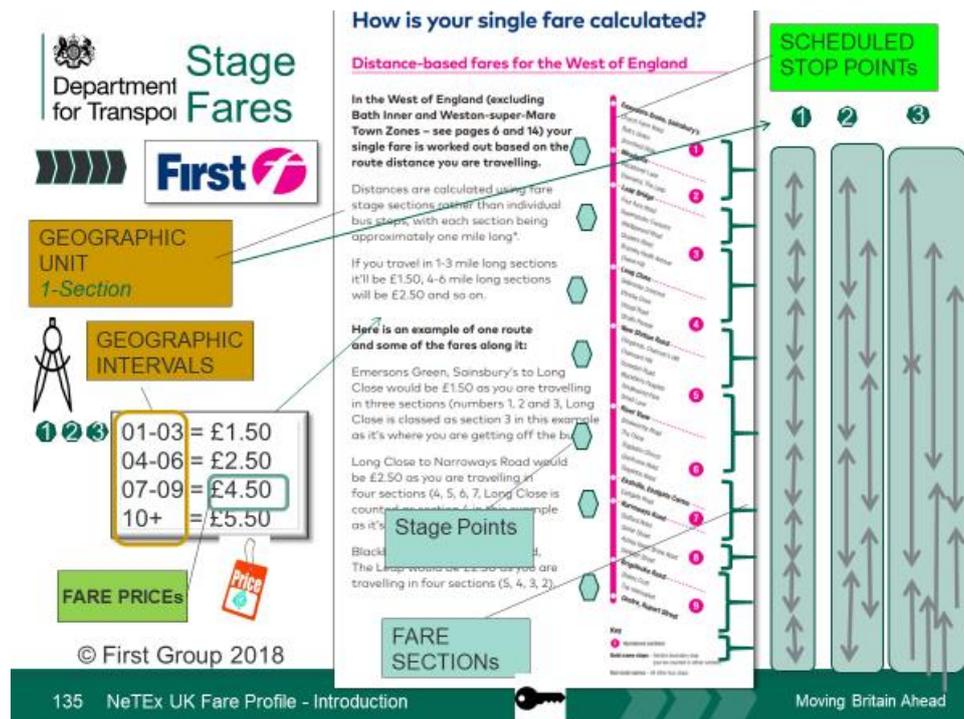


Figure 60 Example – First West of England Section fares – Component use

6.3.5 Product Summary

We can summarise the overall composition of the *First West Of England* Tariff using NeTEx components as shown in the figure below.

The Network comprises as number of SCHEDULED STOP POINTs, grouped together as FARE SECTIONS along a route.

The TARIFF defines a set of GEOGRAPHICAL INTERVALs, each representing a certain number of sections (3,6, 9,12, etc), one of which may be selected.

- Each GEOGRAPHICAL INTERVAL has an associated GEOGRAPHICAL INTERVAL PRICE. To price a journey, the number of units consumed between the start and end stop is used to look up the appropriate price.
- The tariff structure also includes separate USER PROFILEs for adults, youths and children, one of which may be selected.
- There are USAGE PARAMETERs to define the conditions on travel; ROUND TRIP (Single only), INTERCHANGING (not allowed), CAN BREAK JOURNEY (not allowed). These are fixed and apply always.

The PREASSIGNED FARE PRODUCT has a VALIDABLE ELEMENT, giving access rights to make a trip using a single GEOGRAPHICAL INTERVAL, a single USER PROFILE, and subject to the travel conditions.

There are two different SALES OFFER PACKAGEs, offering the same PREASSIGNED FARE PRODUCT; one with a *paper ticket* TYPE OF DOCUMENT, available through an on-board or at stop DISTRIBUTION CHANNEL; and the other with a *mobile app* TYPE OF DOCUMENT, available through a mobile on-line DISTRIBUTION CHANNEL.

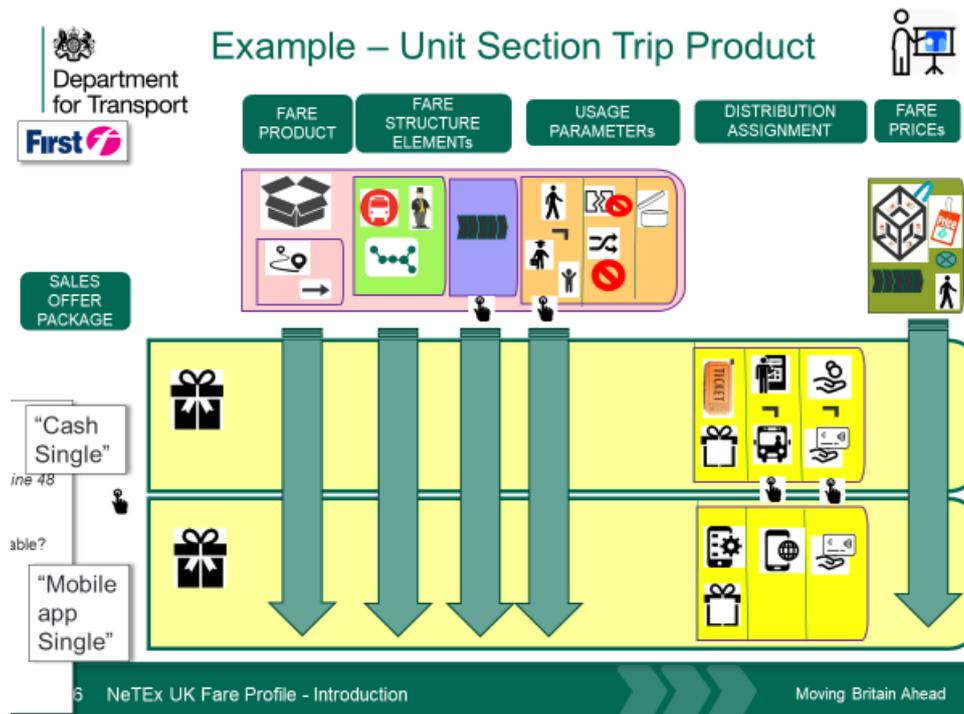


Figure 61 Example – First West of England Section fares – Summary of offers

6.3.6 Price Table

There are FARE PRICES for each combination of SALES PACKAGE (i.e. TYPE OF DOCUMENT), GEOGRAPHICAL INTERVAL and USER PROFILE.

Stage fare trip

- (SALES OFFER PACKAGE) x GEOGRAPHICAL INTERVAL x USER PROFILE x

6.3.7 Further discussion

6.3.7.1 Specifying fare stages

An application such as a journey planner, that wishes to price a unit priced journey, will have to determine the number of units consumed by a given trip between two stops. Having determined this, it may then look up the appropriate GEOGRAPHICAL INTERVAL PRICE. If the units are individual stops, the number of units can be calculated simply by counting stops. Otherwise the stages must be indicated in the journey pattern.

- To mark the fare stages A SERIES CONSTRAINT can be created, flagging specific FARE POINTS in PATTERN as fare stages.
- In addition, FARE SECTIONS starting and ending at each successive fare stage, can be created. The SECTIONS can be used to provide visualisations to passengers of the stops between each stage.

6.3.7.2 Combining tariff types in a single fare.

The pricing of bus fares in the Bristol central zone is zonal, with a flat fare applying; outside of this zone, the unit section fare discussed above apply. A passenger can buy a single ticket to make a journey into or out of the zone, that combines both flat and distance tariffs to arrive at a single overall price. *“If a journey begins within a flat fare zone but travels beyond the border of that zone, the fare will be calculated as follows: Flat fare to the border of the zone, then rounded up to £2.50, £3.50, £4.50 or £5.50 depending on the distance travelled thereafter.”* Thus to price the overall journey the two parts must be considered together.

To represent this accurately in NeTex, a FARE STRUCTURE ELEMENT containing two successive FARE STRUCTURE ELEMENTs IN SEQUENCE would be used in the TARIFF. The first ELEMENT IN SEQUENCE, describing the access rights to the inner zone (with flat pricing) and the second the access rights to a unit number of fare sections (With interval based pricing). This allows all the relevant parameters for pricing the trip to be stated so that a pricing engine can combined them in the required order and treat the composite journey as a single calculation.

FARE STRUCTURE ELEMENTs IN SEQUENCE can be used wherever there is a tariff structure involving components that must be consumed in a particular order.

6.4 Example 4: Multi-trip Carnet (Metrorider)

Multi-trip carnets give regular users of bus transport a discount on their travel if they buy a bundle of tickets at a reduced price. Carnets may be for single trips or for day passes and may come in different quantities at different discounts. Usually they must be used within a specified validity period.

The Metrorider product sheet from Example 2 also listed a multi-trip carnet on the right, details of which are shown below. This also serve to provide an example of two different products that make use of the same network description and use the same media.

6.4.1 Key features

- Zonal tariff.
- Single trip in Zone.
- 5, 10 and 15 trip bundles.
- Multiple user types; Adult, Child.
- Smartcard media only.

6.4.2 FXCP Scope



Basic profile.

6.4.3 Fare sheet

the key at our Travel shops  

Crawley Metrorider

	1 day	1 week	4 week	13 week	Annual	Evening **	5 journeys	10 journeys	25 journeys
Adult	£4.60	£19.50	£64.50	£170	£565	£4	£12	£23	£53.50
Child	£2.50	£10.50	£35.50	£86	£310	-	£6.25	£11.75	£27
Student	£3.45	£14.65	£48.40	£127.50	£423.75	-	-	-	-

Multi Trip - Single journeys grouped onto the key to use one at a time:

	5 journeys	10 journeys	25 journeys
Adult	£12	£23	£53.50
Child	£6.25	£11.75	£27
Student	-	-	-

** Available from 1800 and valid until 0359 on the following day.

Horsham Metrorider

	1 day	1 week	4 week	13 week	Annual
Adult	£4.60	£19.50	£64.50	£170	£565
Child	£2.50	£10.50	£35.50	£86	£310
Student	£3.45	£14.65	£48.40	£127.50	£423.75

Multi Trip - Single journeys grouped onto the key to use one at a time:

	5 journeys	10 journeys	25 journeys
Adult	£12	£23	£53.50
Child	£6.25	£11.75	£27
Student	-	-	-

Redhill & Reigate Metrorider

	1 day	1 week	4 week	13 week	Annual
Adult	£4.60	£19.50	£64.50	£170	£565
Child	£2.50	£10.50	£35.50	£86	£310

Multi Trip - Single journeys grouped onto the key to use one at a time:

	5 journeys	10 journeys	25 journeys
Adult	£12	£23	£53.50
Child	£6.25	£11.75	£27

Metrovoyager

	1 day	1 week	4 week	13 week	Annual
Adult	£7.20	£25.70	£92	£275	£910
Child	£4	£17	£57	£165	£650
Student	£5.40	£19.30	£69	£206.25	£682.50

Metrovoyager tickets are also valid on all Brighton & Hove bus services.

metrobus.co.uk/thekey

Figure 62 Example Metrobus Multitrip- Fare sheet

6.4.4 Zone map

As for Metrorider pass

6.4.5 Product Summary

We can summarise the overall composition of the *Metrobus Multi-trip product* using NeTeX components as shown in the figure below.

The Network comprises a set of FARE ZONES, as for the Metrorider pass product.

The TARIFF defines a set of FARE QUALITY FACTORS each representing a certain number of trips (5, 10, 25), one of which may be selected.

- The tariff structure also includes separate USER PROFILES for adults, and children, one of which may be selected, so that a carnet of adult or child ticket can be bought.
- A USAGE VALIDITY PERIOD specifies the “sell by” date period within which the trips must be made.

An AMOUNT OF PRICE UNIT product has a VALIDABLE ELEMENT giving access rights to make a single trip within a single FARE ZONE, for a single USER PROFILE, and subject to the travel conditions.

There are four SALES OFFER PACKAGES, one for each different FARE ZONE, all offering the same PREASSIGNED FARE PRODUCT, all specify only a smartcard as the TYPE OF DOCUMENT.

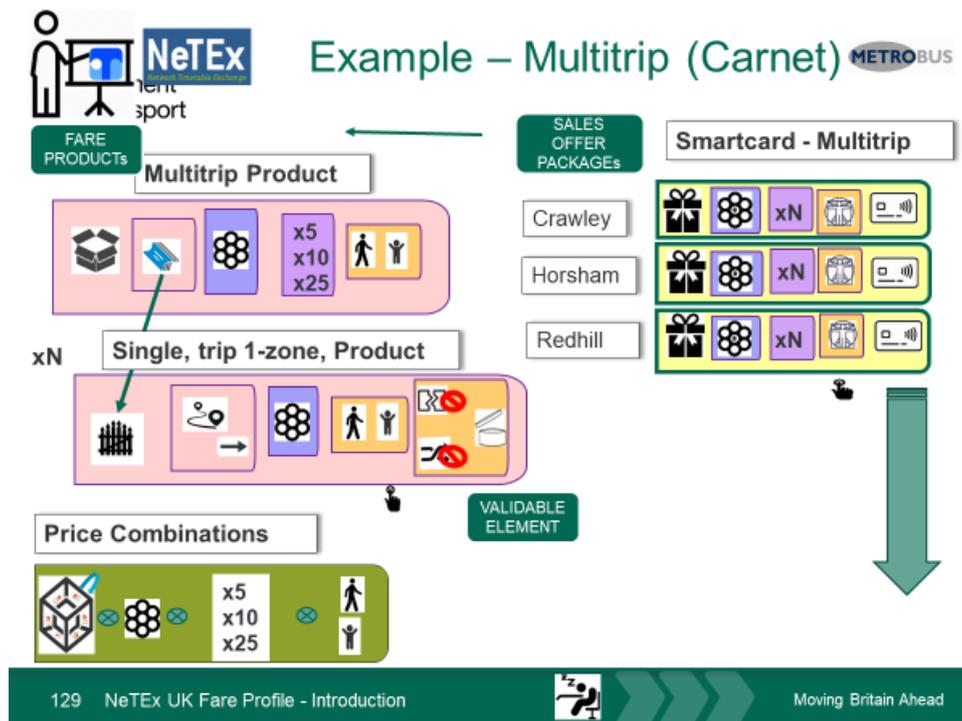


Figure 63 Example Metrorider Multi-trip carnet – Summary of offer

6.4.6 Price Table

There are FARE PRICES for each combination of SALES PACKAGE (i.e. FARE ZONE), FARE QUALITY FACTOR and USER PROFILE.

Zonal Fare

- (SALES OFFER PACKAGE & FARE ZONE) x FARE QUALITY FACTOR x USER PROFILE

6.5 Multiple products for the same area.

It is not unusual for there to be a number of different products and tariffs giving access rights to a particular service. For example, if we consider the simple *Metrobus Line 1* fare sheet from Example 1, as well as the simple cash fares, we also see mention of five other products that give access rights to Line1, including the *Metrorider* Pass (Example2) and the *PlusBus* Pass.

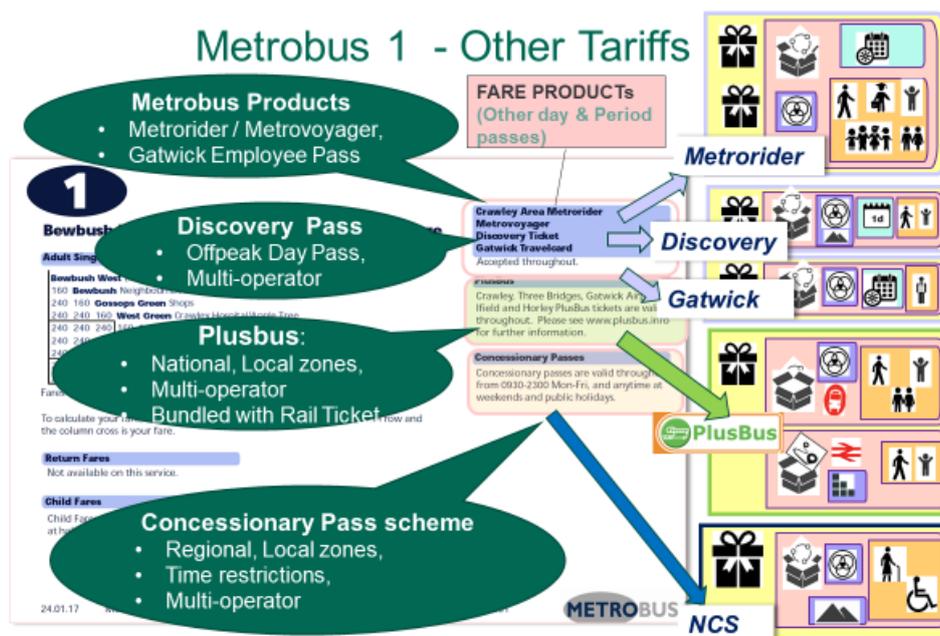


Figure 64 Example – Metrobus Line1 – Other products

In the above example, the presentation of passenger information brings together what are entirely separate products on to the same fare sheet. In data terms, each of the products should be specified with a separate specification and will usually be exchanged as a separate XML document (referring as appropriate to the same underlying network elements such as stops and tariff zones). A consumer system, such as a journey planner, must take the separate definitions and determine which is the best to offer for a specific type of user for specific trip or trips.

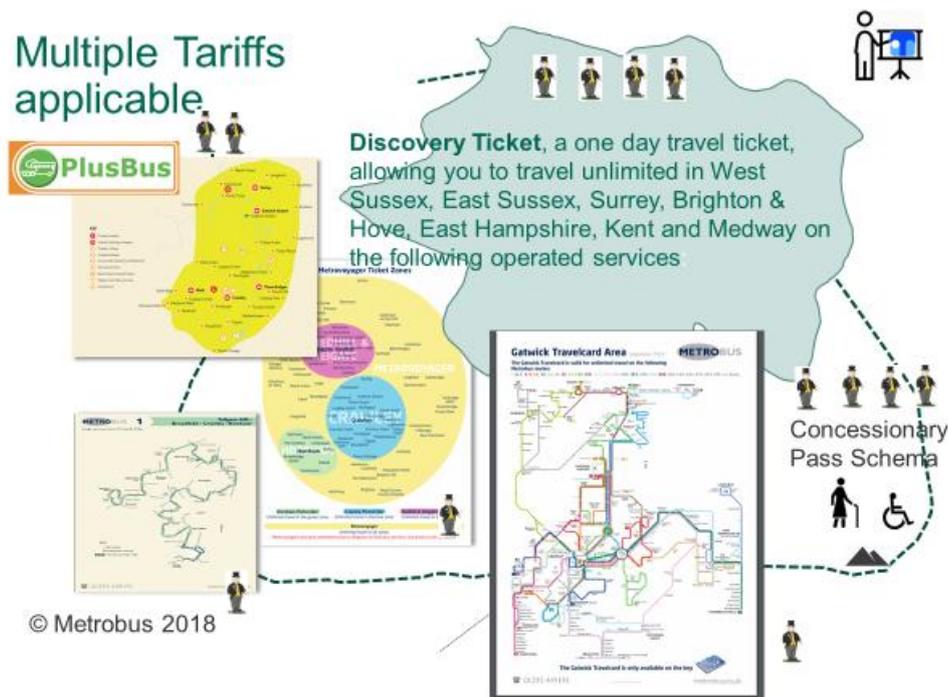


Figure 65 Example – Multiple tariffs

7 Extended profile Examples

This section summarises products with additional features reported in the FXCP extended profile.

7.1 Example 5: Multi-operator Pass (Avonrider)

A multi-operator product allows passengers to travel on the services of more than one operator with the same ticket or pass. An example is the Travelwest *Avon rider* pass, which is accepted by First and other operators in the West of England.

Conceptually such a product is little different from a single operator pass; its access rights will specify additional OPERATORS, and probably a more extensive set of NETWORKS or LINES, but otherwise be very similar.

7.1.1 Key features

- Zonal tariff.
- 1-day and 1-Week Intervals.
- Multi-operator participation.
- Multiple user types; Adult, Child, Student.
- Smartcard and paper tickets.

7.1.1 FXCP Scope



Extended fare profile.

7.1.2 Fare sheet

Ticket Info

AvonRider prices are set by the bus operators and are:

	Adult	Student (with NUS card) and Child (under 16)
AvonRider Day	£7.20	£5.50
AvonRider Week	£32.50	£24.50

Figure 66 Example – Avonrider – Fare sheet

7.1.3 Zone map



Figure 67 Example – West of England Network – Fare Zones

7.1.4 Product Summary

The overall composition of the *Travelwest Avonrider* Tariff in NeTex components is similar to that of the *Metrorider* product.

The network comprises three individual FARE ZONES nested within a fourth overall zone.

There is a single PREASSIGNED FARE PRODUCT, defining a period pass that give access rights for unlimited travel in one of the different fare zones for the duration of two different TIME INTERVALS.

The TARIFF references the set of FARE ZONES, one of which may be selected.

- The Tariff includes TIME INTERVALS, for one day and for one week.

UK Bus Fares Profile

- The tariff has FARE STRUCTURE ELEMENTs with VALIDITY PARAMETER ASSIGNMENT to the participating OPERATORs or GROUPs OF OPERATORs.
- The tariff structure also includes separate USER PROFILEs for adults, children and students, one of which may be selected.
- There are USAGE PARAMETERs to define the conditions on travel; INTERCHANGING (allowed), FREQUENCY (unlimited). These are fixed and apply always.

The PREASSIGNED FARE PRODUCT has a VALIDABLE ELEMENT giving access rights to travel in a ZONE, for a single USER PROFILE subject to the travel conditions.

Two different types of ticket media (TYPE OF TRAVEL DOCUMENT) are available; paper, and smartcard, each associated with different payment methods

7.1.5 Price Table

There are FARE PRICES for each combination FARE ZONE, TIME INTERVAL and USER PROFILE

Zonal Fare

- FARE ZONE x TIME INTERVAL x USER PROFILE x (SALES OFFER PACKAGE)

7.2 Example 6: Multi-operator supplement (PlusBus)

The UK PlusBus product is available nationally as a zonal bus add-on to a rail ticket. It is a supplement – i.e. requires the purchase of another product (a single or return trip, or a season pass), and may be purchased either bundled in with a rail ticket or as a separate purchase later, but only for the origin and or destination stations of a rail ticket.

PlusBus zones, centred round rail stations are defined in the NPTG data set with a name and a boundary polygon. For each zone, specific operators participate or do not participate and there may be specific services excluded.

7.2.1 Key features

- Supplement to another product.
- Zonal tariffs.
- Day and Season passes.
- Multi operator, core product with local participation exceptions.
- Multiple user types.
- Discounts for rail cards.
- Rail card purchase has different pricing for peak and off-peak travel.
- Available on paper and also on smart card in certain areas.

7.2.2 FXCP Scope



Extended fare profile.

7.2.3 Fare sheet

Each *PlusBus* zone has a set of prices, and a set of local conditions as to participating operators - e.g. See the Crawley web page from the *Plusbus* site below.

There is also a set of Railcard discounts which apply nationally.

Plus Bus tariff - Crawley

PlusBus Add urban bus travel to your train ticket.

Search by postcode: GO > Search by town: GO >

Crawley, Gatwick Airport, Horley, & Three Bridges PlusBus

A Crawley, Gatwick, Horley or Three Bridges PlusBus ticket gives you unlimited bus travel on participating operators services, around the whole urban area of Crawley, Gatwick, Horley, and Three Bridges, as shown by the shaded maps (below).

Interchange stations
 Crawley (Station Way), Gatwick Airport, Horley (Oldfords Rd), Three Bridges (Market Ave).

Day prices:

Adult	£2.00
Child	£1.00
Railcard holder	£2.43

Season prices:

	Adult	Price / Day
2-week	£16.00	£1.14
Month	£72.00	£2.40
Quarter	£176.00	£2.28
Annual	£660.00	£1.87

Child discount: half adult season ticket price.

Railcard discount restrictions for PLUSBUS

Railcard holders get 1/3 off the adult price of PLUSBUS day tickets. Some Railcards have retail restrictions, please see individual items below. Sorry, Railcards do NOT give a discount off any PLUSBUS season ticket price.

NETWORK Railcard (Annual Gold Card) holders get 1/3 off the adult price of PLUSBUS day tickets for towns and cities located within the South East of England, upon presentation of their valid Network Railcard (Annual Gold Card), as follows:
 Mondays to Fridays after 19:30hours.
 Saturdays, Sundays, Bank Holidays any time.
 The £13 minimum fare restriction does not apply to PLUSBUS day ticket purchases.

Two Together Railcard holders get 1/3 off the adult price of PLUSBUS day tickets, upon presentation of their valid Two Together Railcard, as follows:-
 Mondays to Fridays after 09:30hours.
 Saturdays, Sundays, Bank Holidays any time.
 You must buy 2 tickets at the same time.

16-25 Railcard, 26-30 Railcard & HM Forces Railcard holders get 1/3 off the adult price of PLUSBUS day tickets, upon presentation of their valid 16-25 or 26-30 Railcard or HM Forces Railcard, at all times.
 The £12 minimum fare restriction does not apply to PLUSBUS day ticket purchases.

Senior Railcard holders get 1/3 off the adult price of PLUSBUS day tickets, upon presentation of their valid Senior Railcard, as follows:-
 outside of the South East of England at all times,
 in the South East after the Monday to Friday morning peak period* (excluding Bank Holidays) for a journey wholly within the South East region.
 * times of off-peak services vary by route, but generally related to the availability of Off-Peak tickets.

Disabled Persons Railcard holders get 1/3 off the adult price of PLUSBUS day tickets, upon presentation of their valid Disabled Persons Railcard at all times, when purchased with the following rail ticket types:
 Off-Peak Day Singles, Off-Peak Day Returns;
 Anytime Singles, Anytime Returns;
 Advance fares.
 Disabled Persons discounts are valid during the morning peak hours.

Family&Friends Railcard
 Adult travellers get one third off the adult PLUSBUS day ticket price upon presentation of their valid Family&Friends Railcard outside of the South East of England at all times, in the South East after the Monday to Friday morning peak period* (excluding Bank Holidays) for a journey wholly within the South East region.
 * times of off-peak services vary by route, but generally related to the availability of Off-Peak tickets.
 Children MUST be charged the normal child PLUSBUS day ticket price (which is half the adult fare).

Figure 68 Example – PlusBus Crawley – Fare sheet

7.2.4 Zone map

There are many PlusBus Zones across the country, centred round rail stations: the following figure shows the zones around Crawley and Gatwick

Interoperating fares – eg Plus Bus : Zonal add on for rail tickets

FARE ZONES

TOPOGRAPHIC PLACES

Zones around country

- Multiple participating Bus operators
- Exceptions in each zone
- Sold via rail sales channels

Figure 69 Example – PlusBus Crawley – Zone Map

7.2.5 Component Use

The *PlusBus* tariff itself is a simple zonal tariff. A full description of its pricing and conditions requires a specification for a Railcard (as a SALES DISCOUNT RIGHT) a separate product from another provider. There are different Railcards targeted at different types of user, so in fact the same SALES DISCOUNT RIGHT product is marketed as different SALES OFFER PACKAGES for different USER PROFILES.

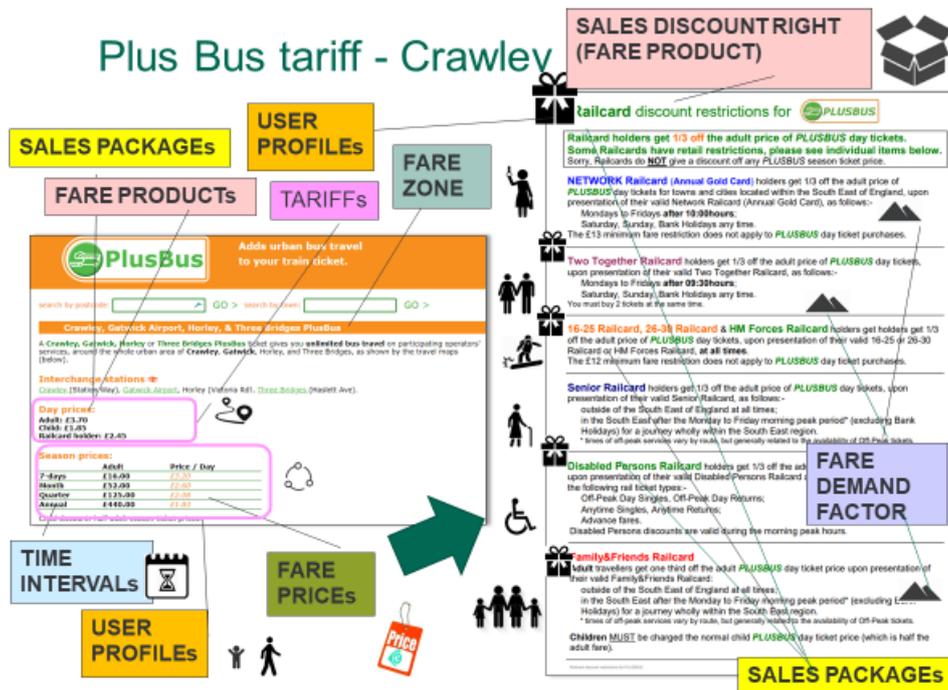


Figure 70 Example – PlusBus Crawley – Component use

The prerequisite rail product (a trip or season pass) may be specified as one of a number of SALES OFFER PACKAGE, whose ENTITLEMENTS GIVEN include the *PlusBus* product.

Complex condition of travel (FARE DEMAND TYPE) and commercial conditions apply to these fares

Access rights & Conditions – UK Rail fares

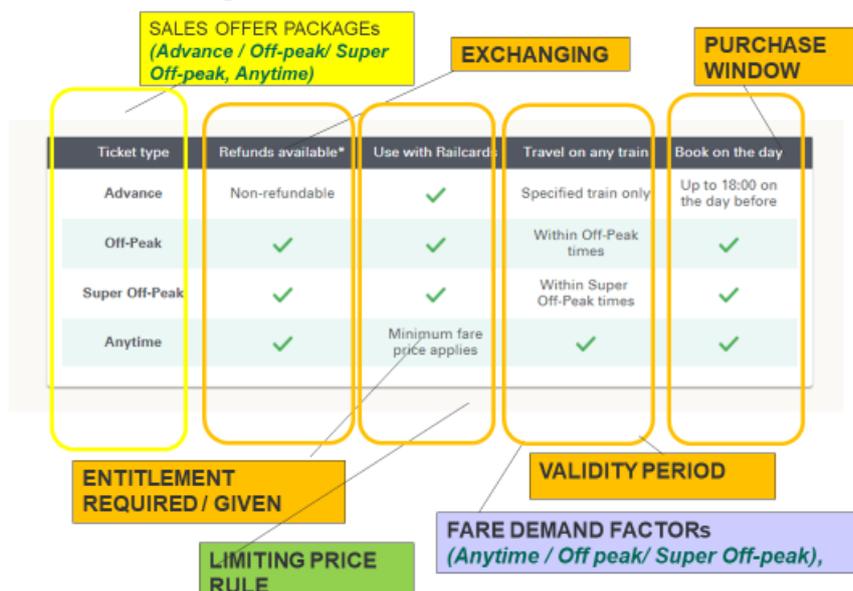


Figure 71 Example – UK Rail products– Component use

7.2.6 Product Summary

The basic composition of the *PlusBus* Tariff in NeTeX components is similar to the other zonal passes discussed above.

- There is a NeTeX FARE ZONE for each NPTG PlusBusZone.
- There are separate SUPPLEMENT PRODUCTS for the *PlusBus* day and the *PlusBus* season pass, each giving access rights for unlimited travel in a specified fare zone for the duration of its respective TIME INTERVAL. Separate products are used for the day and season product because they have different prerequisites – (i.e. a rail day or season ticket) and also there are a number of other conditions attached).
- The SUPPLEMENT products reference the rail products (for single trips, return trips and passes) which can be described separately as products in their own right and be specifically referenced with an ENTITLEMENT REQUIRED on the appropriate *PlusBus* SUPPLEMENT. Conversely, the definitions of the rail products can use ENTITLEMENTS GIVEN elements to indicate that the *PlusBus* package can be purchased
- There are SALE OFFER PACKAGES for the allowed combinations of product (Season, or day) with different media. (Paper, smartcard, pass)
- There are different prices for different USER PROFILES (*adult, child* etc.).
- There are discounts for holders of specific rail cards.

To represent the Rail card discount, a further NeTeX FARE PRODUCT type is used, a SALES DISCOUNT RIGHT.

- A SALES DISCOUNT RIGHT is a FARE PRODUCT that gives the right to a discount when purchasing other products (rather than actually to travel). It may have its own price. ENTITLEMENT GIVEN parameters can be used to specify which other products it covers.

UK Bus Fares Profile

- Different SALES OFFER PACKAGES may be created to customise the same rail card SALES DISCOUNT RIGHT product for different USER PROFILEs (*Senior, Student, etc.*).
- Restrictions on the time of travel apply to some rail tickets and some similar restrictions may also apply to the *PlusBus* use. These can be represented in NeTeX as FARE DEMAND FACTOR elements.

Compared to the locally scoped *Metrorider* pass, further complexity arises in the full *PlusBus* product definition because of the need to scale nationally, and because there are references to three other product sets (rail trips, rail season passes and railcards) from a different provider.

1. In each TARIFF ZONE, only certain OPERATORS may decide to participate and furthermore, certain LINES may be excluded, either always or at certain times of day. These inclusions and exclusions can be specified as access rights to groups of included or excluded OPERATORS and LINES in the normal manner. However, in order to allow a distributed workflow to collect and maintain the local rules across the country, the conditions should be modularised; that is, the inclusions/exclusions for each area should be placed in a separate XML document. Thus, the complexity is largely to do with modularising and managing the workflow documents rather than with the actual product specification.
2. The prerequisite Rail products (trips and passes) and the ENTITLEMENTS GIVEN should be specified in a different frame as they have a different provider.

We can illustrate an outline modularisation of a national *PlusBus* product as follows.

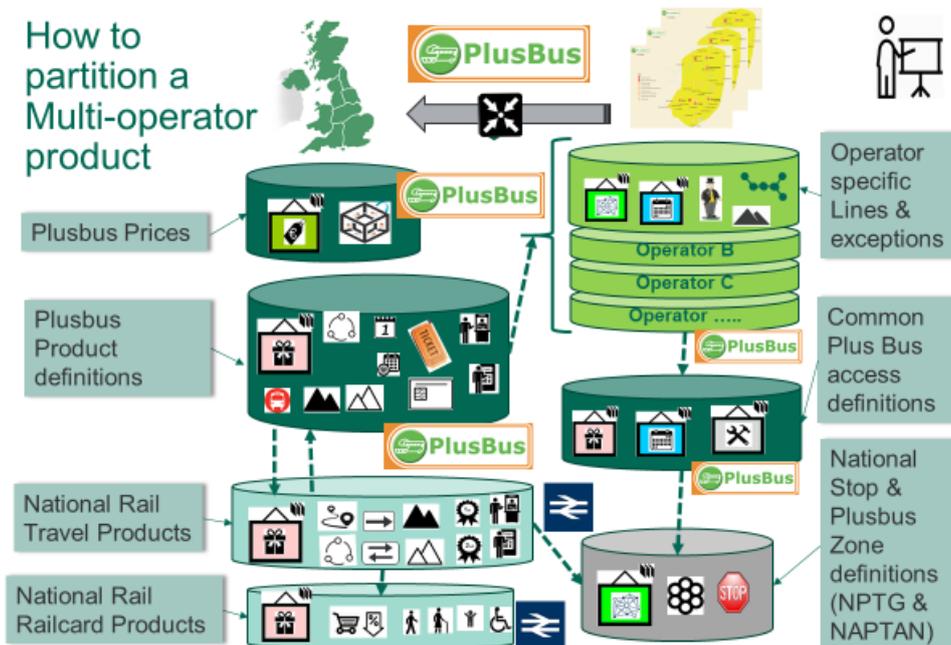


Figure 72 Example – PlusBus Crawley – Modularisation

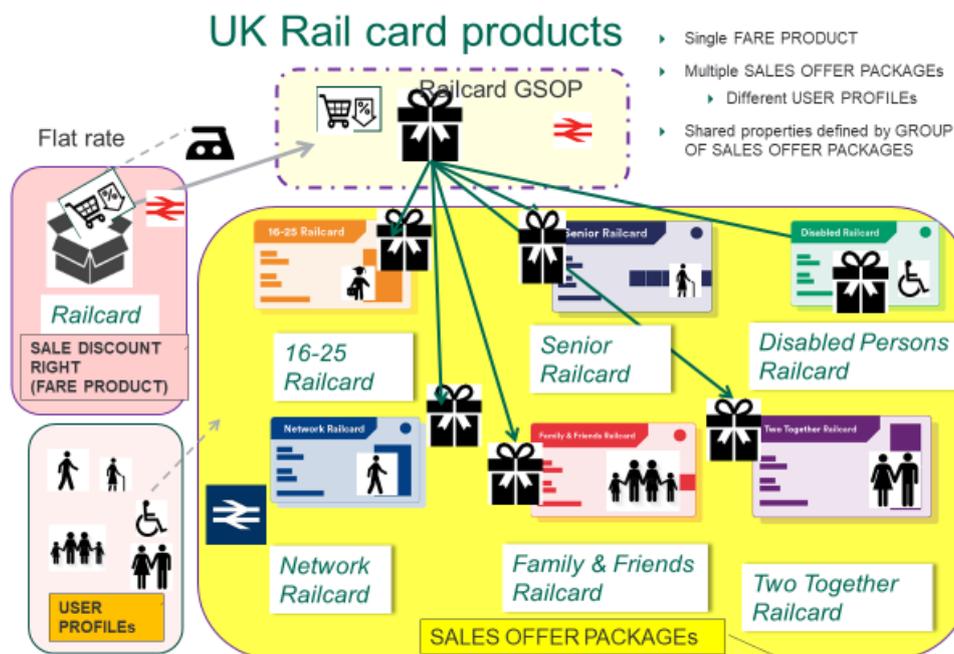


Figure 73 Example – Railcard SALES DISCOUNT RIGHT – Summary of Offer

7.2.7 Price Table

There are FARE PRICES for each combination of FARE ZONE, TIME INTERVAL and USER PROFILE, with reduced prices for Railcard holders.

Zonal Fare

- FARE ZONE x TIME INTERVAL x USER PROFILE x (SALES OFFER PACKAGE) x (DISCOUNT RIGHT).

7.3 Example 7: Capped Sales Discount

The integrated fare products of large metropolitan areas, such as London are complex both because of their scale (with many different modes and networks being covered by a variety of integrated products) and also because they use modern fare systems to cope with the volume of people. An advanced feature seen in TfL’s system, but likely also to become widely used elsewhere with the roll out of mobile and lower cost PAYG systems, is **fare capping**. With capping, a user’s consumption of travel within a time period is capped so that it is no more than the cost of a pass for the same interval.

Here we give a brief overview of how even complex tariff structures for fare products such as TfL’s Oyster card can be represented in a similar manner to more basic fares, using the same network and tariff components and with the addition of one more type of Fare Product.

7.3.1 Key features

- Multiple modes with different tariff structures.

UK Bus Fares Profile

- Zonal tariffs (named zones), point-to-point and flat tariffs.
- Single trip and pass products.
- Capped Pay-as-you-go travel for account-based products.
- Multiple user types.
- Group tickets.
- Peak and off fare demand periods.
- Multi-trip-carnets for specific modes.
- Validity period varies with the number of zones travelled.
- Paper, Smartcard and contactless card media.
- Personal and anonymous account-based ticketing.

7.3.2 FXCP Scope



Extended fare profile – CAPPED DISCOUNT RIGHT.

UK  NB Support for rail and integrated metropolitan fare products is out of scope for the FXCP.

7.3.3 Fare Sheet

The TfL price tariff is multidimensional, with different tariff structures for different modes and different prices for electronic and cash payment.

Transport for London

Accessibility | Help & Contact | Sitemap

Search: Search

Home | Live travel news | Getting around | **Tickets** | Road users | Corporate | Business & partners

Tickets > Fares

Tube, DLR and London Overground | National Rail | Single fare finder | Bus and tram | River | Emirates Air Line

Save money with Oyster pay as you go

- Store credit and use it journey by journey
- Never run out of credit with Auto top-up
- Cheaper than cash for single fares

Travelcards

- Travel as much as you like, as often as you like
- Add Travelcards to your Oyster card

Adult | 18+ student | 16-18 | 11-15 | 5-10 | Jobcentre Plus | Bus & Tram | Railcard | Groups

Adult

You need an Oyster card to:

- Use pay as you go and daily price capping
- Buy 7 Day, Monthly and longer period Travelcards

You do not need an Oyster card to pay cash single fares or to buy Day Travelcards.

Zone	Cash	Oyster pay as you go				Travelcards				
		Peak single	Off-peak single	Peak price cap	Off-peak price cap	Day Anytime	Day Off-peak	7 Day	Monthly	Annual
Zone 1 only	£4.50	£2.10	£2.10	£8.40	£7.00	£8.80	£7.30	£30.40	£116.80	£1,216
Zones 1-2	£4.50	£2.80	£2.10	£8.40	£7.00	£8.80	£7.30	£30.40	£116.80	£1,216
Euston - Zone 2*	£4.50	£2.20	£2.10	£8.40	£7.00	£8.80	£7.30	£30.40	£116.80	£1,216
Zones 1-3	£4.50	£3.20	£2.70	£10.60	£7.70	£11.00	£8.00	£35.60	£136.80	£1,424
Euston - Zone 3*	£4.50	£3.00	£2.70	£10.60	£7.70	£11.00	£8.00	£35.60	£136.80	£1,424
Zones 1-4	£5.50	£3.80	£2.70	£10.60	£7.70	£11.00	£8.00	£43.60	£167.50	£1,744
Euston -	£5.50	£3.40	£2.70	£10.60	£7.70	£11.00	£8.00	£43.60	£167.50	£1,744

Figure 74 Example – TfL – Part of Fare sheet

7.3.4 Zone Map

TfL’s zone map is a classical ‘doughnut’ fare zone system of concentric rings

TfL bus single trip fares are flat rate but capped to a daily limit.

TfL Bus day and season passes are zonal.

Note that London also has examples of other modes with bus like tariffs (river, cablecar, tram) as well as underground and rail fares that are distinct.

Use of sections of the national rail that fall within the London area is permitted (and can be described with SECTION elements).

Zone Doughnut - TfL Zones

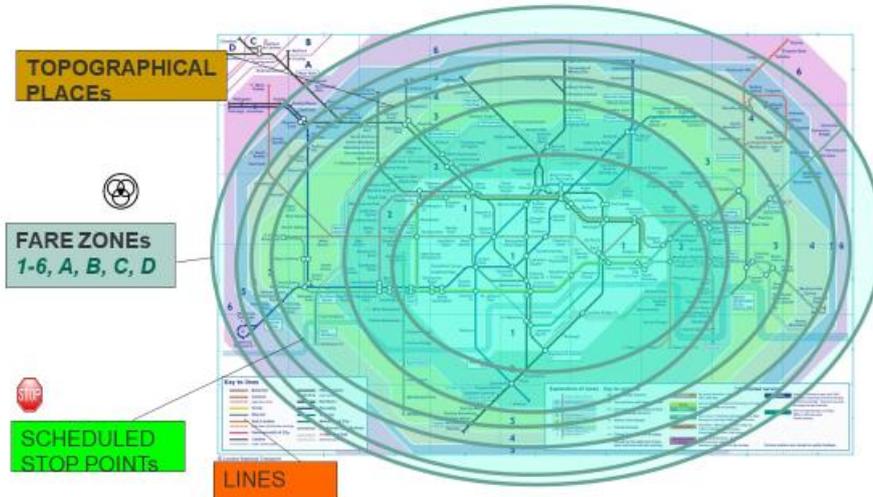


Figure 75 Example – TfL Zone map

7.3.5 Component Use

The NeTEx element used to represent the TfL Tariff structure are similar to other those shown earlier

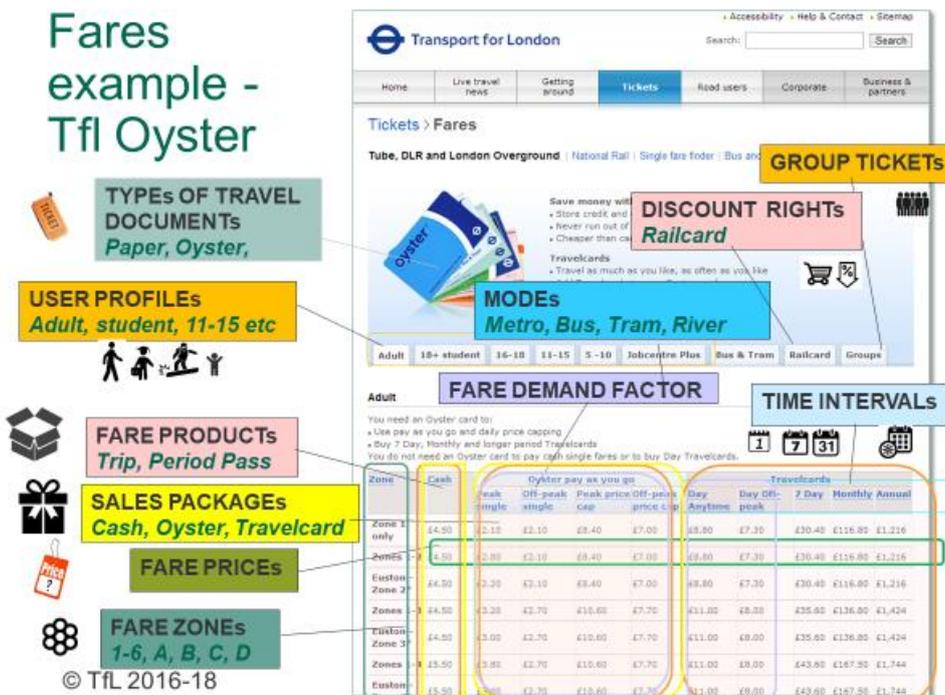


Figure 76 Example – TfL Tariff Structure – Component use

7.3.6 Product Summary

The TfL network has both classical paper ticket products and electronic PAYG products

7.3.6.1 Classical products

The walk-up single trip paper tickets that may be purchased from ticket machines, are represented by a classical set of SALES OFFER PACKAGES and PREASSIGNED FARE PRODUCTS for individual modes or combinations of modes. These are available for different USER PROFILES and for GROUP TICKETS. The Network comprises as number of SCHEDULED STOP POINTS, grouped together as FARE ZONES. Certain sections of the rail network are included in zones, and can be described as FARE SECTIONS and assigned to FARE ZONES.

- The zonal TARIFF used for the underground, DLR and for bus day passes (Travelcard) is defined as a set of FARE STRUCTURE ELEMENTS for each permitted combination of TARIFF ZONE (and duration of travel), one of which may be selected.
- For single trip use, the FARE STRUCTURE ELEMENT also specifies a USAGE VALIDITY PERIOD for each zone combination (as there is a limit on the total travel time allowed that depends on the zones covered)
- The point-to-point tariff used for many river services is represented by DISTANCE MATRIX ELEMENTs (there are also river passes and “hop on hop off” trips allowing journey breaks).
- The flat rate tariff used for the cable car is represented by a single FARE STRUCTURE ELEMENT and price for the MODE

All of the tariffs have multiple USER PROFILES.

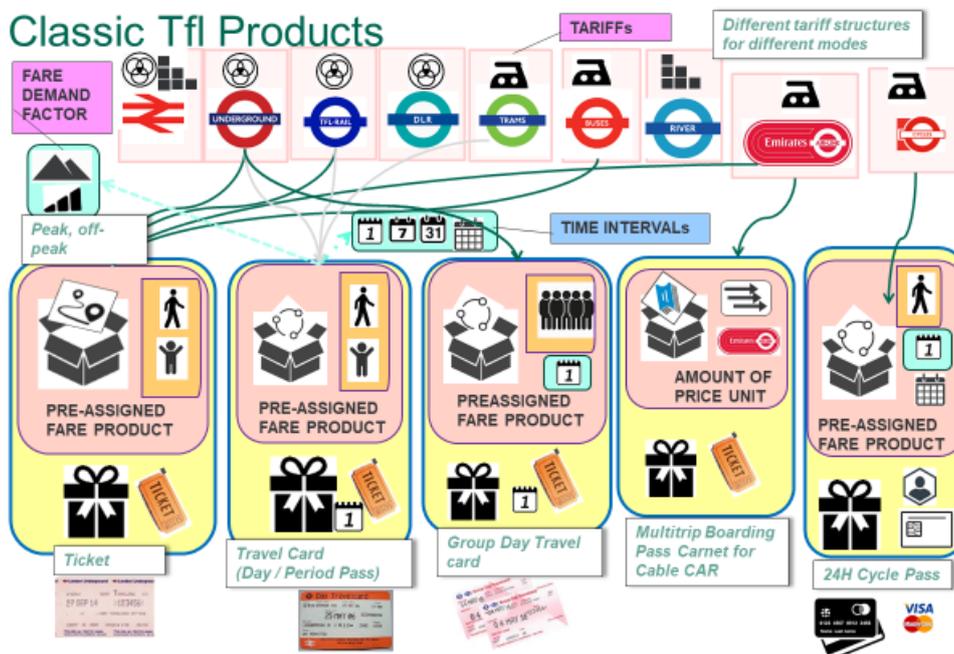


Figure 77 Example – TfL Classical products – Offer Summary

7.3.6.2 Electronic products

UK Bus Fares Profile

TfL has two different media types for its electronic products (that is, TYPES OF TRAVEL DOCUMENT); (i) the *Oyster Smartcard* and (ii) use of any contactless EMV (credit or debit) payment card. Both of them support capping but over different periods and subject to different commercial conditions. Only travel on certain modes (Tube, bus, DLR and rail) is capped. The two offerings can be represented as two different SALES OFFER PACKAGES, each bundling a number of different FARE PRODUCTS up into a single marketable offering.

Thus, the *Oyster Smartcard* SALES OFFER PACKAGES contents include:

- A CAPPED SALE DISCOUNT RIGHT (the right to buy individual trips at a discount and to have total charges capped) valid for certain modes. CAPPING RULES can be used to limit the capping to specific modes.
- A SALE DISCOUNT RIGHT to get discounted travel, but not capping, on other modes, such as river.
- An AMOUNT OF PRICE UNIT to represent the stored value balance on the *Oyster Smartcard* TYPE OF TRAVEL DOCUMENT, linked to an online CUSTOMER ACCOUNT in TfL's back office.
- A USAGE DISCOUNT RIGHT (The Emirates cable car gives a rebate on frequent use).

The card also stores the purchases of PRE ASSIGNED FARE PRODUCTS, made when for actual PAYG travel is consumed, each linked to the appropriate VALIDABLE ELEMENT giving access rights to make a trip; Single trips are charged on a capped PAYG basis. TravelCard passes can also be stored to give access rights for specified zones,

The *Contactless Oyster* is similar, but with different capping rights, and no balance or usage discount. The contactless product (and consumption of travel for it) is held entirely in the cloud, with only an identity token being held on the media.

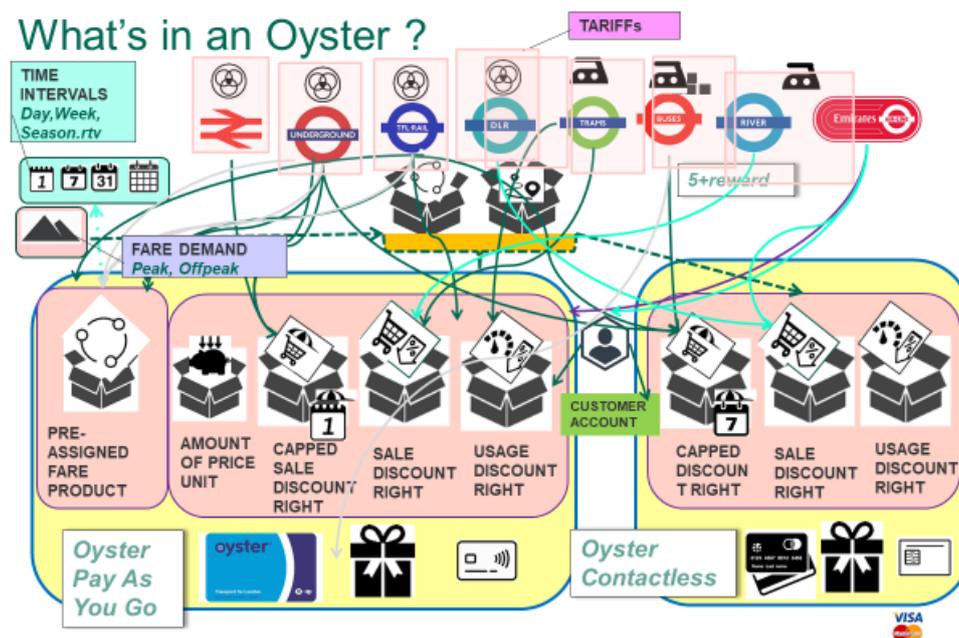


Figure 78 Example – TfL Oyster – Offer Summary

In point of fact, as for Railcards, there are actually different SALES OFFER PACKAGES for each of the different USER PROFILES for which Oyster is marketed – Adult, Child, Youth, Senior etc.

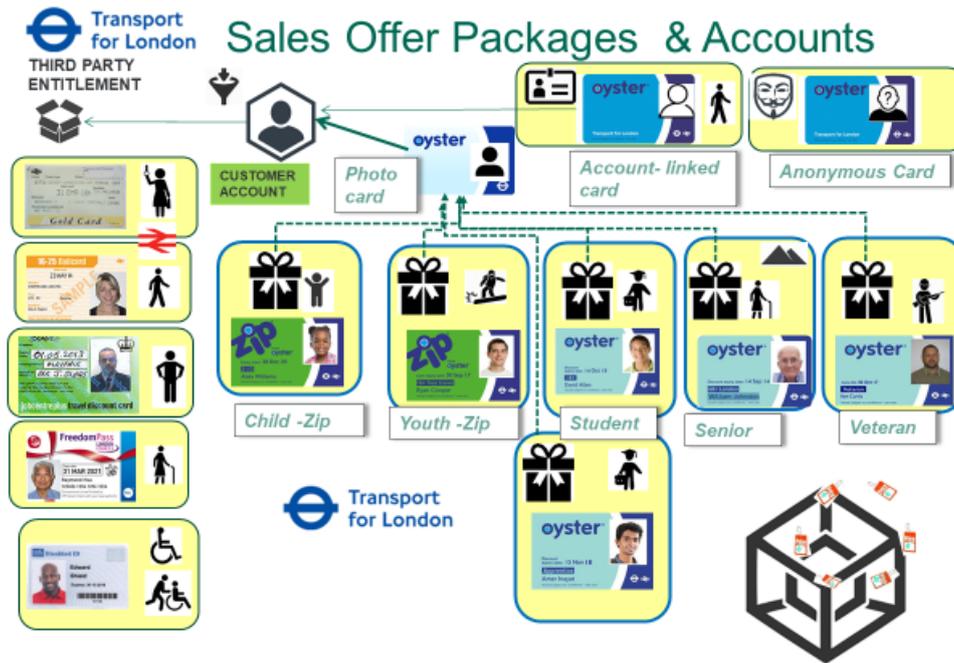


Figure 79 Example – Oyster card variants – Offer Summary

8 Exclusion examples

In this section, as a means of further clarifying the scope of the FXCP, we give brief illustrations of some further tariff and product structures that are excluded from the profile.

8.1 Excluded – True distance-based fares

The FXCP does not include tariff structures that are directly based on distance (although they are supported by the NeTEx Schema) – as in the following example from Romanian railways.

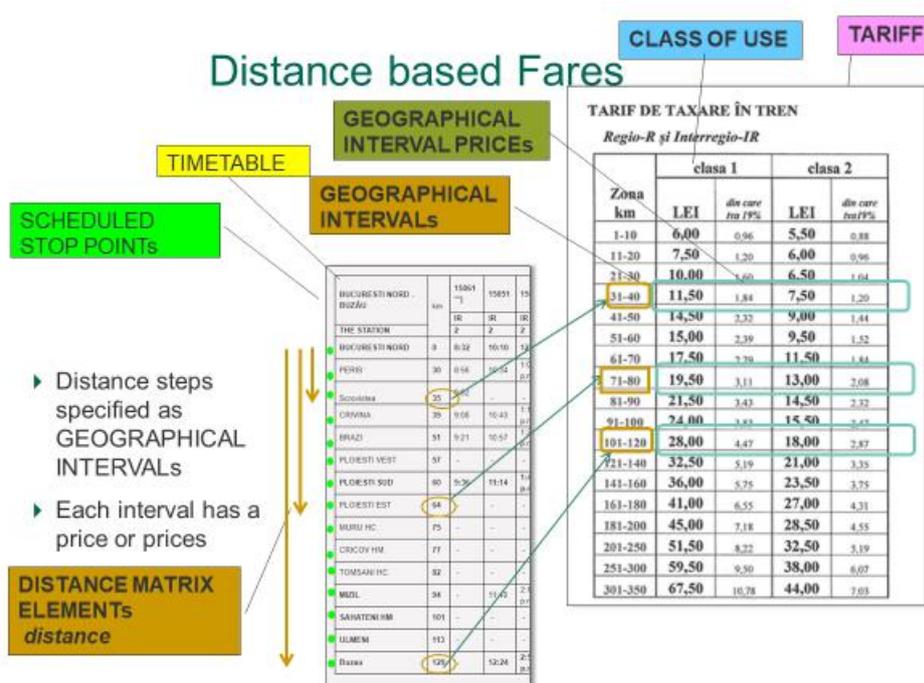


Figure 80 Excluded Example – Distance based fares

8.1 Excluded – Routing restrictions

A complex feature of tariff structures. excluded from the UK Bus profile (but available in NeTEx) is the use of routing restrictions that limit access to a specific route or routes, or change a different fare for travel by different routes. In NeTEx routings or routing envelopes can be specified (and if necessarily be given a separate price) using a SERIES CONSTRAINT.

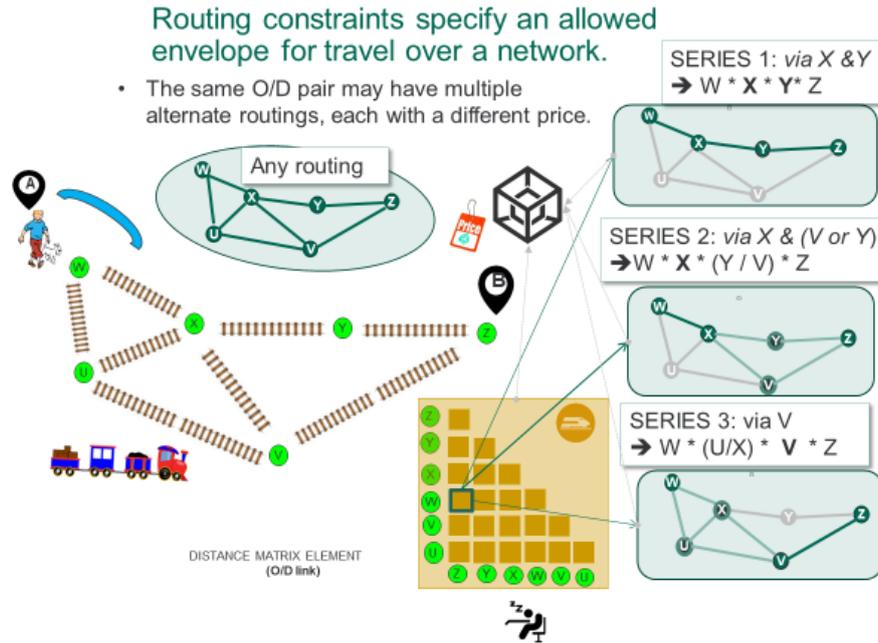


Figure 81 Excluded Example – Routing restrictions

8.1 Excluded – Complex travel time restrictions

For congested metropolitan areas, fare products may have restrictions on travel at peak and off-peak times. For rail and underground products these restrictions may be complex with the timebands varying from stop to stop along a line and according to the direction of travel. Such restrictions can be represented in NeTeX using the FARE DEMAND FACTOR and other elements, but are outside of the scope of the FXCP.

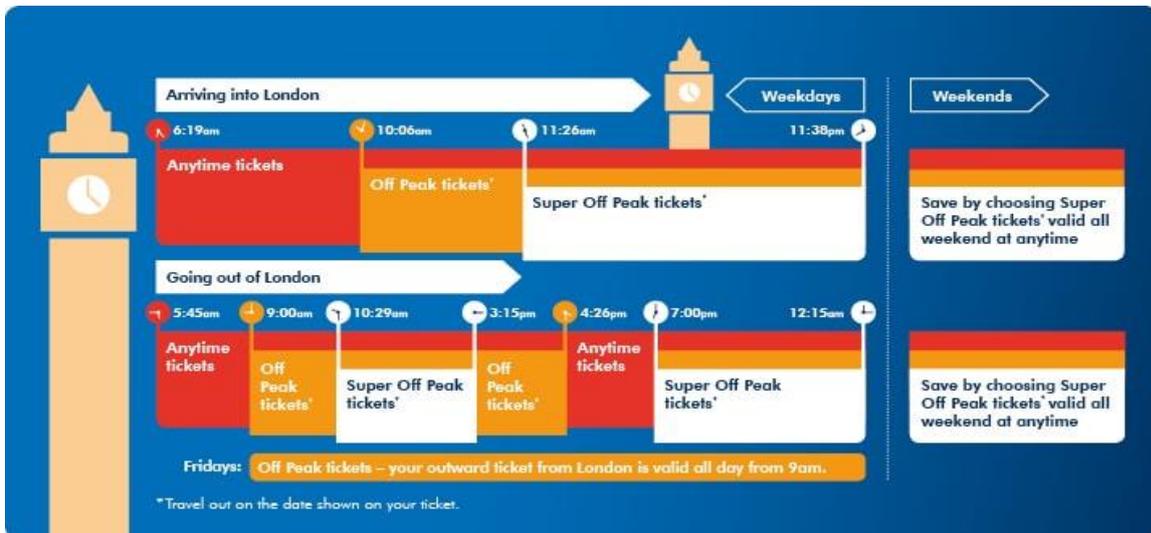


Figure 82 Excluded Example – Time restrictions for rail

Stations north of Moor Park or Hatch End and Southern Region stations

If you travel from a station north of Moor Park or Hatch End on a weekday after the times below, your Oyster single fare will count towards the off-peak cap instead of the peak cap.

North of Moor Park

Station	Touch in times
Chesham	After 09:00
Amersham	After 09:10
Chalfont & Latimer	After 09:15
Chorleywood	After 09:15
Rickmansworth	After 09:20

North of Hatch End

Station	Touch in times
Bushey	After 09:20
Carpenders Park	After 09:20
Watford High Street	After 09:10

Figure 83 Excluded Example – Stop dependent Time restrictions for rail